

# ELECTIVE SUBJECTS

## INDIAN LANGUAGES

### Aims:

1. To enable students to use the language to communicate thoughts, ideas and information.
2. To develop the ability to use the language innovatively and creatively for interpreting and summarising information gained through various learning experiences.
3. To develop the habit of clear articulate expression, using accepted syntactical forms and structures in the language.
4. To expose students to a deeper knowledge and appreciation of all categories of literary works in the language.

### CLASSES XI & XII

*There will be two papers in the subject:*

**Paper I - Theory:** 3 hours..... 80 Marks

**Paper II - Project Work** ..... 20 Marks

### PAPER I (THEORY): 80 Marks

*There will be one paper of **three** hours duration, which will consist of two sections:*

**Section A:** Language (40 marks)

**Section B:** Prescribed Textbooks (40 marks)

3. **Grammar:** Functional grammar - correction of sentences and using words/idioms in sentences, viz. correct structure with proper agreement of the subject and verb according to the number, gender, case, tense and voice.

(10 Marks)

#### SECTION A

#### LANGUAGE – 40 Marks

This section will consist of **three** questions, all of which will be compulsory.

1. **Composition:** One composition of 400 words approximately, in the language, to be written out of a choice of 6 topics set within the experience and mental maturity of the age-group of the candidates.

(15 Marks)

2. **Comprehension:** An unseen passage of about 300 words to be set with questions and/or summary (with heading to test the ability to summarise and/or to expand an idea given in the passage).

(15 Marks)

#### SECTION B

#### PRESCRIBED TEXTBOOKS – 40 Marks

Candidates will be required to answer **four** questions from **any three** of the prescribed textbooks.

**NOTE:** *The Class XII - ISC Examination paper will be set on the entire syllabus prescribed for the subject.*

*The Class XI Examination is to be conducted on the portion of this syllabus that is covered during the academic year.*

*The Council has not prescribed bifurcation of the syllabus prescribed for this subject.*

*For list of Prescribed Textbooks, see Appendix I.*

## PAPER II (PROJECT WORK): 20 Marks

In addition to the syllabus prescribed above for Classes XI and XII, candidates are also required to be assessed in Project Work. Details of the same are given below:

### PROJECT WORK FOR CLASS XI

Project Work in Class XI comprises of assessment of candidates in Listening, Speaking and Writing skills. These are to be *assessed internally* by the School, during course work and shown in the student's report and school record.

Candidates are to be assessed in *three* projects, one each on **Listening, Speaking and Writing Skills**.

Details of Projects in Listening, Speaking and Writing Skills are given below:

#### Listening Skills

An unseen passage of about 500 words or a poem (of appropriate length) may be read aloud, twice, the first time at normal reading speed and the next time at a slower speed. The passage/poem may be taken from any book, newspaper, magazine, journal and so on but **not from an ICSE or ISC textbook**. A suitable audio clip may also be used.

*Students may make brief notes during the readings/playing of the audio clip, followed by answering objective type questions based on the passage/poem/audio clip, on the paper provided.*

#### Speaking Skills

Students are to be assessed through an individual presentation, e.g. extempore speaking, declamation, recitation, debate, of about three minutes followed by a discussion with the subject teacher, for another two or three minutes.

List of suggested assignments for Project Work:

1. Narrating an experience
2. Giving directions or instructions on how to make or operate something
3. Providing a description
4. Giving a report
5. Expressing an opinion or a theme-based conversation

6. Giving a speech on a selected topic
7. Reading out, after correcting, a grammatically incorrect passage/s of suitable length (150- 200 words) based on the prescribed grammar syllabus.

#### Writing Skills (Language/Literature)

A piece of written work of about 600 – 800 words must be produced on any aspect of Language or the portion of the Literature syllabus covered in Class XI.

List of suggested assignments for Project Work:

1. Product/process description
2. Description of an event
3. An autobiographical experience
4. Review of a book/serial/play/performance
5. Summary or paraphrase of a chosen text from the syllabus
6. Selecting another story/poem on a theme studied in the syllabus and writing a summary of it
7. Giving an alternative title to a story or poem studied in the syllabus and justifying the same

### EVALUATION

**Internal Evaluation by the Teacher (20 Marks):**

Assessment Criteria	Description	Marks
<b>Listening Skills (Aural)</b>	Response to questions based on listening comprehension	6
<b>Speaking Skills (Oral)</b>	Content, Fluency, Vocabulary, Sentence structure, Confidence level	6
<b>Writing Skills</b>	Process, Content, Presentation, Originality	8
<b>TOTAL</b>		<b>20</b>

## PROJECT WORK FOR CLASS XII

Project Work in Class XII comprises of assessment of candidates in *three* projects, *one each* on **Listening, Speaking and Writing Skills**.

Listening and Speaking skills are to be **assessed internally**, by the School in Class XII.

Writing Skills are to be **assessed externally** by the **Visiting Examiner, appointed locally and approved by the Council**.

Details of assignments for Project Work are given below:

### **Listening Skills (to be internally assessed by the subject teacher)**

An unseen passage of about 500 words or a poem (of appropriate length) may be read aloud, twice, the first time at normal reading speed and the next time at a slower speed. The passage/poem may be taken from any book, newspaper, magazine, journal and so on but **not from an ICSE or ISC textbook**. A suitable audio clip may also be used.

*Students may make brief notes during the readings/playing of the audio clip, followed by answering objective type questions based on the passage/poem/audio clip, on the paper provided.*

### **Speaking Skills (to be internally assessed by the subject teacher)**

Students are to be assessed through an individual presentation, e.g. extempore speaking, declamation, recitation, debate, of about three minutes followed by a discussion with the subject teacher, for another two or three minutes.

List of suggested assignments for Project Work:

1. Narrating an experience
2. Giving directions or instructions on how to make or operate something
3. Providing a description
4. Giving a report

5. Expressing an opinion or a theme-based conversation
6. Giving a speech on a selected topic
7. Reading out, after correcting, a grammatically incorrect passage/s of suitable length (150 - 200 words) based on the grammar syllabus prescribed for Classes XI and XII.

### **Writing Skills (Literature): to be assessed externally by the Visiting Examiner**

Candidates will be required to undertake *one written assignment of 1000-1500 words* on a text/texts studied in the Literature syllabus.

The objective is to produce original, creative and insightful perspectives on a literary text or set of texts which may be from the short stories/ poems/ drama/ novel from the syllabus.

**The text/texts analysed in the Class XI Project Work must not be repeated in Class XII.**

### **List of suggested assignments for Project Work:**

1. Writing a short story based on a poem.
2. Writing a poem based on a story.
3. Analysing the relevance of a selected story/couplets in the present-day context.
4. Imagining an alternate outcome or ending or extension of the chosen text and its impact on the plot/setting/characters/mood and tone.
5. Providing an alternate title to a given text and giving a justification for the same.
6. Imagining oneself as one of the main characters of the story/novel/drama and describing what one would like to change in the story/novel/drama, giving reasons for the same.
7. Analysing the theme of the story/poem/novel and expressing one's opinion on the same.
8. Summarising / paraphrasing of the chosen text.

9. Preparing a script for dramatization, based on the short story/poem chosen.
10. Comparing and contrasting two characters/themes from different short stories/poems of the prescribed texts.
11. Appreciation of literary qualities of the chosen text.
12. Analysing the background (historical, cultural, literary context) and relevance of the works of the writer/poet chosen.
13. Critical analysis of a news story published in four different newspapers.
14. Writing an article for a newspaper (news writing of an event).

### EVALUATION

**Marks (out of a total of 20) should be distributed as given below:**

1.	Internal Evaluation by Teacher*	
	Listening Skills (Aural)	5 Marks
	Speaking Skills (Oral)	5 Marks
2.	External Evaluation by the Visiting Examiner of Writing Skills**	10 Marks
<b>TOTAL</b>		<b>20 Marks</b>

### \*Internal Evaluation by the Teacher (10 Marks)

Assessment Criteria	Description	Marks
Listening Skills (Aural)	Response to questions based on listening comprehension	5
Speaking Skills (Oral)	Content, Fluency, Vocabulary, Sentence structure, Confidence	5
<b>TOTAL</b>		<b>10</b>

### \*\*Evaluation by the Visiting Examiner (10 Marks)

Assessment Criteria and Description		Marks
1.	Process (Identification of the topic, planning and preparing a written outline)	2
2.	Presentation (Overall formatting: headings, sub-headings, paragraphing, writing within the word limit and providing a separate title page)	2
3.	Content (Use a range of literary aspects in order to present an organized and well-structured complete assignment with proper introduction, main body and conclusion)	4
4.	Originality	2
<b>TOTAL</b>		<b>10</b>

**NOTE: No question paper for Project Work will be set by the Council.**

# MODERN FOREIGN LANGUAGES

Papers on the following Modern Foreign Languages will be set on application:

(a) Chinese (826), (b) French (828), (c) German (829), (d) Tibetan (835), (e) Spanish (836)

## CLASSES XI & XII

*There will be two papers in the subject:*

**Paper I - Theory:** 3 hours..... 80 Marks

**Paper II - Project Work** ..... 20 Marks

### PAPER I (THEORY): 80 MARKS

*There will be **one** paper of **three** hours duration of 80 marks.*

1. A short composition in the language. A choice of subjects will be given.
2. A passage in the language for unprepared translation into English.
3. An unseen passage in the language with questions based upon it. Candidates may be required to make a summary in the language of part of the passage and to answer other questions of the following types: explanation of individual words or phrases or sentences; questions to test comprehension. Questions of all these types will not necessarily be set at any one given examination.
4. Questions on prescribed textbooks. Candidates will be required to answer two questions on one or two of the prescribed textbooks.

*In Foreign languages for which texts are not available, Part 4 will consist of -*

- (a) one passage for translation from the language into English.
- (b) one passage for translation from English into the language.

Schools that have candidates offering a foreign language should consult/contact the Council in time, regarding prescribed textbooks.

**NOTE:** *The Class XII - ISC examination paper will be set on the entire syllabus prescribed for the subject.*

*The Class XI examination is to be conducted on the portion of this syllabus that is covered during the academic year.*

*The Council has not prescribed bifurcation of the syllabus prescribed for this subject.*

*For list of Prescribed Textbooks see Appendix I.*

## PAPER II (PROJECT WORK): 20 Marks

In addition to the syllabus prescribed above, candidates are also required to be assessed in Project Work.

Details of the same are given below:

### PROJECT WORK FOR CLASS XI

Project Work in Class XI comprises of assessment of candidates in Listening, Speaking and Writing skills. These are to be *assessed internally* by the School, during course work and shown in the student's report and school record.

Candidates are to be assessed in *three* projects, one each on **Listening, Speaking and Writing Skills**.

Details of Projects in Listening, Speaking and Writing Skills are given below:

#### Listening Skills

An unseen passage of about 500 words or a poem (of appropriate length) may be read aloud, twice, the first time at normal reading speed and the next time at a slower speed. The passage/poem may be taken from any book, newspaper, magazine, journal and so on but **not from an ICSE or ISC textbook**. A suitable audio clip may also be used.

*Students may make brief notes during the readings/playing of the audio clip, followed by answering objective type questions based on the passage/poem/audio clip, on the paper provided.*

#### Speaking Skills

Students are to be assessed through an individual presentation, e.g. extempore speaking, declamation, recitation, debate, of about three minutes followed by a discussion with the subject teacher, for another two or three minutes.

#### **List of suggested assignments for Project Work:**

1. Narrating an experience
2. Giving directions or instructions on how to make or operate something
3. Providing a description
4. Giving a report

5. Expressing an opinion or a theme-based conversation
6. Giving a speech on a selected topic.

#### Writing Skills (Language/Literature)

Candidates will be required to undertake *one written assignment of about 200 words* on any aspect of Language /Literature syllabus covered in Class XI.

#### **List of suggested assignments for Project Work:**

1. Product/process description
2. Description of an event
3. Summary or paraphrase of a chosen text from the syllabus
4. Providing an alternate title to a given text and giving a justification for the same.
5. Selecting another story/poem on a theme studied in the syllabus and writing a summary of it.
6. Giving an alternative title to a story or poem and justifying the same.

### EVALUATION

#### **Internal Evaluation by the Teacher (20 Marks):**

Assessment Criteria	Description	Marks
<b>Listening Skills (Aural)</b>	Response to questions based on listening comprehension	6
<b>Speaking Skills (Oral)</b>	Content, Fluency, Vocabulary, Sentence structure, Confidence level	6
<b>Writing Skills</b>	Process, Content, Presentation, Originality	8
<b>TOTAL</b>		<b>20</b>

## PROJECT WORK FOR CLASS XII

Project Work in Class XII comprises of assessment of candidates in *three* projects, *one each* on **Listening, Speaking and Writing Skills**.

Listening and Speaking skills are to be **assessed internally**, by the School in Class XII.

Writing Skills are to be **assessed externally** by the **Visiting Examiner, appointed locally and approved by the Council**.

Details of assignments for Project Work are given below:

### Listening Skills (to be internally assessed by the subject teacher)

An unseen passage of about 500 words or a poem (of appropriate length) may be read aloud, twice, the first time at normal reading speed and the next time at a slower speed. The passage/poem may be taken from any book, newspaper, magazine, journal and so on but **not from an ICSE or ISC textbook**. A suitable audio clip may also be used.

*Students may make brief notes during the readings/playing of the audio clip, followed by answering objective type questions based on the passage/poem/audio clip, on the paper provided.*

### Speaking Skills (to be internally assessed by the subject teacher)

Students are to be assessed through an individual presentation, e.g. extempore speaking, declamation, recitation, debate, of about three minutes followed by a discussion with the subject teacher, for another two or three minutes.

#### **List of suggested assignments for Project Work:**

1. Narrating an experience
2. Giving directions or instructions on how to make or operate something
3. Providing a description
4. Giving a report
5. Expressing an opinion or a theme-based conversation
6. Giving a speech on a selected topic.

### Writing Skills (Language/Literature): to be assessed externally by the Visiting Examiner

Candidates will be required to undertake *one written assignment of about 250 words* on any aspect of Language /Literature syllabus covered in Class XII.

#### **List of suggested assignments for Project Work:**

1. Summarising / paraphrasing of the chosen text.
2. An autobiographical experience.
3. Review of a book/serial/play/performance.
4. Writing a short story based on a poem.
5. Writing a poem based on a story.
6. Analysing the relevance of a selected story/couplets in the present-day context.
7. Imagining an alternate outcome or ending or extension of the chosen text and its impact on the plot/setting/characters/mood and tone.
8. Imagining oneself as one of the main characters of the story/novel/drama and describing what one would like to change in the story/novel/drama, giving reasons for the same.
9. Analysing the theme of the story/poem/novel and expressing one's opinion on the same.

## EVALUATION

**Marks (out of a total of 20) should be distributed as given below:**

1.	Internal Evaluation by the <b>Teacher*</b>	5 Marks
	Listening Skills (Aural)	5 Marks
	Speaking Skills (Oral)	
2.	External Evaluation by the <b>Visiting Examiner</b> of Writing Skills**	10 Marks
<b>TOTAL</b>		<b>20 Marks</b>

**\*Internal Evaluation by the Teacher (10 Marks)**

S. No.	Assessment Criteria	Description	Marks
1.	Listening Skills (Aural)	Response to questions based on listening comprehension	5
2.	Speaking Skills (Oral)	Content, Fluency, Vocabulary, Sentence structure, Confidence	5
<b>TOTAL</b>			<b>10</b>

**\*\*Evaluation by the Visiting Examiner (10 Marks)**

Assessment Criteria and Description		Marks
1.	Title and introduction	1
2.	Presentation (Overall formatting: headings/ sub-headings, paragraphing, writing within the word limit and providing a separate title page)	3
3.	Content (Present an organized and well-structured complete assignment with proper introduction, main body and conclusion/comments)	5
4.	Originality	1
<b>TOTAL</b>		<b>10</b>

**NOTE: No question paper for Project Work will be set by the Council.**



# HISTORY (851)

## Aims:

1. To provide accurate knowledge of significant events and personalities of the period under study, in sequence and in context.
2. To familiarize candidates with factual evidence upon which explanations or judgements about the period must be founded.
3. To develop an understanding of the existence of problems and relevance of evidence of explanations.
4. To develop the capacity to marshal facts and evaluate evidence and to discuss issues from a historical point of view.
5. To develop the capacity to read historical views in the light of new evidence or new interpretation of evidence.
6. To foster a sense of historical continuity.
7. To encourage diminution of prejudices and to develop a more international approach to world history.
8. To develop the ability to express views and arguments clearly using correct terminology of the subject.
9. To familiarise candidates with various types of historical evidence and to provide some awareness of the problems involved in evaluating different kinds of source materials.

## CLASS XI

There will be **two** papers in the subject:

Paper I: Theory 3 hours ----- 80 marks

Paper II: Project Work -----20 marks

### PAPER I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing fundamental factual knowledge and understanding of the entire syllabus.

**Part II (60 marks)** will be divided into **two** sections, **Section A** and **Section B**, each consisting of **five** questions. Each question shall carry **12 marks**. Candidates will be required to attempt **two** questions from each Section and **one** question from either Section A or Section B. A total of **five** questions will be attempted from Part II.

### SECTION A

#### INDIAN HISTORY

##### 1. Growth of Nationalism

###### (i) Swadeshi Movement

*Partition of Bengal and anti-Partition Movement, leading to the Swadeshi and Boycott Movement: causes, features and impact which should include the aggravation of the Moderate-Extremist clash, and the foundation of the Muslim League. The assessment of the movement should include the positive and negative features.*

###### (ii) Revolutionary Nationalism

*The growth of revolutionary activities should explain what led to the development and concentrate on some well-known organizations: Abhinav Bharat, Yugantar, Anushilan Samiti.*

##### 2. Emergence of the Colonial Economy

###### (i) Development of the means of transport and communication.

*Transportation: a brief look at the development of the railways – other means can simply be mentioned.*

###### (ii) Disruption of traditional economy: British revenue policy: impact on peasants and artisans; poverty and famines.

*A general account of the impact of the British rule on peasants and artisans. Revenue policy: the Permanent Settlement and Ryotwari Settlement should be done in some detail.*

###### (iii) Development of modern industries.

*An account of the growth of large scale machine based industries in western India, its economic impact.*

###### (iv) Colonial Forest Policy - impact on local communities.

*The Forest Acts of 1865 and 1894 to be studied critically. Political and economic impact of the Colonial Forest Policy on local communities.*

### 3. Social and Religious Movements

- (i) Impact of the modern ideas in Europe on Indian administrators.  
*The characteristics of modern thought (liberalism, utilitarianism) to be very briefly explained as a background to British policy.*
- (ii) Reform Movements – Brahmo Samaj, Arya Samaj, Aligarh Movement.  
*A critical look at each of the above movements.*
- (iii) Struggle against caste – Jyotirao Phule, Narayan Guru, Veerasalingam.  
*A brief outline of their contributions.*
- (iv) The Women's Question  
*The following Acts to be studied: Abolition of Sati 1829, Widow Remarriage 1856, Female Infanticide Prevention 1870 and Age of Consent 1891. The background and features have to be read critically to evaluate their impact on women.*

### 4. Protest Movements against Colonial Rule

*A brief account of the Indigo Uprising (1859), Deccan riots (1875), Munda Uprising (1899-1900) and the response of the colonial authority.*

### 5. Gandhian Nationalism (1916 – 1922)

- (i) The launching of the passive resistance movement by Gandhi; background and main features of the movement.  
*A general background of the development of Gandhian ideas of non-violence and satyagraha in South Africa. Brief summaries of the three localised satyagrahas: Champaran, Ahmedabad, and Kheda district.*
- (ii) Agitation against the Rowlatt Act, Jalianwala Bagh (1919), Khilafat and Non-Cooperation Movement (1919-1922).  
*The reasons behind the Rowlatt Act and its main terms to be studied in brief. A general account of the satyagraha against the Act, leading to Jalianwala Bagh and the aftermath.*  
*The launching of the Khilafat and the Non-Cooperation Movements; why Gandhi decided to support Khilafat. There should be a connected chronological account of the movement and its suspension after Chauri Chaura.*

### 6. Gandhian Nationalism (1927 – 1934)

- (i) Simon Commission: its boycott and the demand for Dominion Status by 1929; Lahore session and declaration of 'Poorna Swaraj' as the Congress objective.  
*The reasons for sending the Commission in 1927 as well as its boycott should be briefly explained. A general account of the agitation against the Commission as well as a very brief account of the Nehru Report. The Lahore Session should be set against the expiry of the deadline by the Congress; the main points of the Poorna Swaraj Resolution.*
- (ii) Civil Disobedience Movement (1930-1934).  
*A general account of the development of the Movement and different strands within the Movement; main features of the Gandhi-Irwin Pact. The 1<sup>st</sup> and 2<sup>nd</sup> Round Table Conferences can be put very briefly in context. The resumption of the Movement, the Poona Pact (in the context of the Communal Award) should be touched upon.*

## SECTION B

### WORLD HISTORY

#### 7. Impact of the second phase of industrialization in Europe during the late 19<sup>th</sup> and early 20<sup>th</sup> centuries

- (i) Urbanisation, growth of working class: Workers' movements.  
*Trade Union and Socialist Movements in Germany.*
- (ii) Growth of Women's struggles for rights: Suffragette Movement.  
*Focus on Britain and WPSU: an account of demand for women's right to vote until the election of 1919.*

#### 8. World War I: Causes, events leading to it; major changes in warfare and strategy; peace settlements

*An outline of the main long term causes: alliances, imperial rivalry, arms race, nationalism; short term causes: events from 1908 to 1914: the Moroccan crisis, the annexation of Bosnia-Herzegovina. The main interests of the big powers in the Balkans should be briefly touched upon, particularly Russia and Austria-*

*Hungary, as well as the growth of Balkan nationalism and the two Balkan Wars; the assassination at Sarajevo and how it developed into a major European War.*

*Introduction of new technologies and strategies: trench warfare, use of gas, tanks, air warfare and submarines with one example for each.*

*Reasons for US's entry into the War and a brief account of its contribution.*

*A brief explanation of the various causes for the defeat of the Central Powers.*

### **9. Peace Settlements after World War I and the establishment of the League of Nations**

*Changes in the map of Europe after the Paris Peace Settlements; critical evaluation of the impact of the peace settlements.*

*League of Nations – membership (absence of major powers); establishment of the mandates system; failure of collective security (Manchuria & Abyssinia).*

### **10. The Great Depression**

*Causes leading to the Wall Street Crash of 1929 and its impact on the economy of USA, Germany, Britain, France, & Japan.*

### **11. Rise of Communism: Russia (1917-1939)**

*The Bolshevik Revolution of 1917 - a brief account of events in 1917: March Revolution and its results; explanation of why the Provisional Government fell from power leading up to the November Revolution.*

*Lenin and his consolidation of the Bolshevik state.*

*Struggle for power between Stalin and Trotsky; Single party state under Stalin: the collectivisation of agriculture. The First and the Second Five Year Plans and the purges of 1937-1938.*

### **12. Rise of Fascism: Italy (1919-39)**

(i) Post-War discontent and the rise to power of Benito Mussolini.

*Conditions which gave rise to Fascism; a brief chronological account of the events which brought Mussolini to power from the election of 1921 to the march on Rome in October 1922.*

(ii) Main features of Mussolini's domestic policy. *Critical appraisal of Mussolini's policies particularly his economic policy.*

### **13. Rise of Nazism: Germany (1933-39)**

(i) Rise of Hitler to power and factors assisting his rise.

*Weaknesses of the Weimar Republic as a background to the rise of Nazism; events from 1932 onwards leading to Hitler becoming Chancellor of Germany in 1933; the reasons for his popularity among different groups should be explained.*

(ii) The Nazi State: from 1933 onwards.

*Outline of the changes made by Hitler in government, the cultural life and education, army (the Night of the Long Knives), the economy and religious life. Escalation of the campaign against the Jews should be done in some detail, till the "Final Solution". Reasons why his policies were accepted among different groups.*

### **14. Rise of Militarism: Japan (1919-37)**

Reasons for militarism in the 1930s; expansion into China. Events leading to the attack on Pearl Harbour.

*The political, economic and ideological reasons for the rise of militarism and expansion into China should be explained (emphasis should be laid on the reasons for the attack on Manchuria and a brief account of it). The subsequent developments should be studied chronologically, emphasizing the declaration of a "New Order in East Asia" and the 1937 invasion of China.*

## **PAPER II (PROJECT WORK)**

**- 20 MARKS**

Candidates will be required to undertake **one** project which **may** be any one of the following:

- (i) A case study.
- (ii) A field visit/ investigation.
- (iii) A local history
- (iv) Interview/oral evidence
- (v) Book review/ film review/ posters/ newspapers/ advertisements/ cartoons and art

The project must not be based primarily on the syllabus; students must be encouraged to produce original, creative and insightful perspectives on an allied aspect of the topic.

For example, if the theme is economic development in India, the project could be on a 5-year plan. However, it would have to give the historical perspective and impact.

**The written outcome of the project, in the form of a 2000-word essay, should be structured as given below:**

- A. The research question
- B. Abstract: it must contain the following information:-
  - Reason for choosing the topic.
  - Methods and material to be used in the investigation.
  - Hypothesis: the conclusion the student is hoping to draw.
- C. Main essay: it must follow the structure given below:-
  - Background and context – to be discussed very briefly.
  - Explanation of the theme and specific issue of the research question in the context of the background given above.
  - Interpretation, Analysis and Critical Evaluation of a range of evidence: the research material gathered by the student
  - Conclusion – whether hypothesis stands or not.
  - Bibliography – a list of all material referred to in the essay, including print, electronic, oral & audio-visual material, referenced correctly, in a standard format
  - Appendix – optional, only if it is crucial for the better understanding of the project essay.

**List of Suggested Projects**

1. Tilak
2. Rabindranath Tagore
3. Bhagat Singh/ Chandrasekhar Azad/ Lala Lajpat Rai
4. Growth of Indian political organizations in the late 19<sup>th</sup> - early 20<sup>th</sup> centuries.
5. Change in British policy after 1857.
6. Industrialisation - Impact of the growth of industries on the life style of the people.

7. Birth of totalitarian ideologies - Fascism Communism.
8. Strands in the early 20<sup>th</sup> Century - military and economic rivalries.
9. League of Nations – Peacekeeping actions with regard to Collective Security and Weaknesses.
10. The 1920s Cultural Movement - Jazz Age.
11. Changes in nature of warfare – late 19<sup>th</sup> and early 20<sup>th</sup> century conflicts, World War I.

**EVALUATION CRITERIA:**

**Mark allocation for the Project will be as follows:**

Assessment objective	Criteria	Marks
1. Process	Candidates should be able to: Identify the topic, Plan and detail a research project. Select and use appropriate research methods.	5
2. Understanding, application of knowledge and Analysis	Candidates should be able to: Explain issues and themes clearly and in context. Interpret, analyse and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statements.	5
3. Presentation	Overall format, referencing (footnotes &/or bibliography), within word limit of 2000 words, title page, header/footer, etc.	5
4. Viva	Range of questions based on the project only.	5
<b>TOTAL</b>		<b>20</b>

### **GUIDELINES FOR TEACHERS:**

1. It must be emphasized that the **process** of doing the project is as important as the finished product.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to make out a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference materials could be suggested and even put up on the library notice board for guidance of the students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks must be awarded for content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.

## CLASS XII

There will be **two** papers in the subject:

Paper I: Theory 3 hours ----- 80 marks

Paper II: Project Work -----20 marks

### PAPER I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing fundamental factual knowledge and understanding of the entire syllabus.

**Part II (60 marks)** will be divided into **two** sections, **Section A** and **Section B**, each consisting of **five** questions. Each question shall carry 12 marks. Candidates will be required to attempt **two** questions from each Section and **one** question from either Section A or Section B. A total of **five** questions will be attempted from Part II.

### SECTION A

#### INDIAN HISTORY

#### 1. Towards Independence and Partition: the Last Phase (1935-1947)

- (i) Important political developments: growth of socialist ideas, trade union activities, Kisan Sabha movement; growth of communalism (Hindu & Muslim).

*These developments in the late 1930s and 1940s are to be done briefly.*

- (ii) Working of provincial autonomy: Congress and other ministries.

*The main features of Provincial Autonomy should be explained. A critical account of the election of 1937 and the working of the Congress ministries must be given. A summary of main developments under non-Congress ministries should be included.*

- (iii) National Movement during the Second World War: The outbreak of World War II and the resignation of the Congress ministries, Lahore Session of the Muslim League in 1940 and the deadlock up to the August Offer (1940). Failure of the Cripps Mission; Quit India resolution; arrest of Congress leaders; violent public reaction; Government repression of revolt of 1942.

*Why the Cripps Mission was sent to India should be explained along with its proposals. Reasons for the rejection of its proposals should lead directly to the Quit India*

*resolution. A compact account of the movement, its repression and a brief analysis of its significance is needed.*

- (iv) Subhash Chandra Bose and the INA.

*Bose's role in the national movement and his differences with Gandhi to be discussed. Background to the formation of the IIL and INA; Bose's revival of the INA should be emphasized, a brief account of its operations, eventual defeat and significance.*

- (v) Transfer of power (1945-1947): changed attitude of British Government; the Cabinet Mission Plan proposals; Congress and League reaction; Direct Action by League; communal riots; Attlee's declaration of 1947; the Mountbatten Plan; partition and independence.

*Reasons for change in the attitude of the British government after World War II - Cabinet Mission: its aims and the major provisions of its Plan. Election to the Constituent Assembly and the results. Controversy between Congress and League over the question of: (a) grouping of provinces under the terms of the Plan (b) being part of the Constituent Assembly (c) being part of the Interim Government. Muslim League's Direct Action and communal riots. Congress and Muslim League's decisions on these issues.*

*1947: Attlee's Declaration of 20<sup>th</sup> February 1947; Mountbatten Plan – main features: acceptance of the Plan by major political parties; modifications in the Indian Independence Act. Reasons why the Congress accepted partition.*

#### 2. Establishment and development of Indian democracy (1947 – 1966)

*The following should be discussed:*

- *The refugee problem, the transfer of assets and the river waters dispute.*
- *Origin of the Kashmir problem. The role of Sardar Patel in the reorganisation and integration of princely states with special reference to Junagarh and Hyderabad.*
- *The foundation of Indian Democracy: significance of the first general election*

*based on universal adult suffrage (1952): role of political parties, problems of preparation and their solutions, process, result and impact of the elections.*

- *The linguistic reorganisation of states: movement for linguistic reorganisation with particular reference to Andhra, Bombay and Punjab; redrawing of the map of India on the basis of linguistic identity.*

### **3. Challenges to Indian Democracy (1964 – 1977)**

*The following to be discussed:*

- *The role of the Syndicate: (a) In the appointment of Lal Bahadur Shastri in 1964 and Indira Gandhi in 1966 as prime minister. (b) Importance of the election of 1967: the factionalism in the Congress (Syndicate vs. Indira Gandhi) leading to its split in 1969. Emergence of Opposition political parties and their main leaders.*
- *Naxal Movement: causes of its rise; Historic Eight Documents (main points) as the origin of its ideological basis (1967), main leaders (Charu Majumdar and Kanu Sanyal); areas where they operated (West Bengal and Andhra Pradesh) and the struggle carried out by peasants and students.; government measures against it; reasons for its decline in the 1970's and its impact.*
- *JP Movement (1974-75): Origin: Jai Prakash Narayan's disputes with Mrs. Gandhi; main features of its course; leadership; measures to suppress it. Assessment of its significance and impact (positive and negative features).*
- *Emergency (1975-76): reasons for imposition; main features of the suspension of democratic rights. Assessment of its impact (positive and negative aspects). Possible reasons for withdrawal.*

### **4. Changing face of the Indian Democracy (1977 – 1986)**

- (i) *The Janata Government (1977 – 1979). Restoration of democracy: formation of party and government, its programme and implementation; reasons for its downfall.*
- (ii) *Return of Congress to power (1979 – 1986).*

*Centre-State relations to be studied with reference to:*

- (a) *Punjab: separatist demands and the Centre's response.*
- (b) *Demands in the North-East:*
  - *Assam's agitation against foreigners and the Centre's response (1947-85); main events to be done in detail.*
  - *Nagaland's demand for autonomy and its resolution (1947-80); main events to be done briefly.*
  - *Mizoram Movement (1959-1986) to be touched upon.*

### **5. India's Foreign Policy**

- (i) **Non-Aligned Movement (NAM)**

*Reasons for following a non-aligned policy in the context of the Cold War to be discussed.*

*Aims – Panchsheel.*

*Establishment and growth – Bandung and Belgrade conferences; Cold War and NAM in the 1950s, 1960s and 1970s (brief outlines of India's stance during significant Cold War events): the Korean War, the Vietnam War, the invasion of Hungary, the Arab Israeli conflicts (1956-1979) and the Soviet invasion of Afghanistan.*

- (ii) **Pakistan (1948-49, 1965, 1971)**

*Indo-Pak wars: causes, course and consequences of each to be done separately.*

- (iii) **Sino-Indian War**

*Background: Initial relations with the Peoples' Republic of China; disputes over (a) Tibet issue: Chinese takeover and asylum of the Dalai Lama in India; (b) Border issues.*

*Sino-Indian War (1962): immediate causes and consequences.*

### **6. Movements for Women's Rights**

*A brief outline of the significance of the Towards Equality Report (1974) with regard to women's issues.*

*Developments in the anti-dowry movement and struggle against domestic violence in the 1970s and 1980s.*

**SECTION B**  
**WORLD HISTORY**

**7. World War II**

- (i) Factors leading to the War: aggressive foreign policies of Germany, Italy and Japan.

*Should be discussed in some detail, showing how these aggressive policies made war more likely and worldwide in scope.*

*Reasons for Japan's alliances with Italy and Germany should be briefly explained, leading to the attack on Pearl Harbour.*

- (ii) Anglo-French appeasement policies.

*Appeasement: why Britain and France chose to follow this policy and how it was carried out.*

- (iii) Course of the War: Europe, Africa and Far East. American entry and contribution.

*Main theatres of the War during 1939-1945 should be done separately in chronological order; the main battles should be done in some detail: El Alamein, Stalingrad, Midway, the Normandy landings and the policy of "island hopping" in the Pacific. The US contribution should be done separately for Europe and the Pacific.*

- (iv) Reasons for the defeat of the Axis Powers.

*Each of the reasons for the defeat of the Axis should be explained.*

**8. De-colonisation – in Asia (China) and Africa (Ghana & Kenya)**

- (i) China: civil war and the establishment of the People's Republic in 1949; Mao Tse Tung; agrarian and industrial policy; political and economic developments; contribution of Mao.

*A brief overview of the developments after Chiang Kai-shek's rise to power (1924) to the truce between the KMT and the CCP in 1936 to be given.*

*An outline of the post-war struggle between the KMT and CCP and the victory of the Communists. The causes of Communist victory should be stated and briefly explained.*

*A short background of the problems facing the Communists in 1949: in agriculture, the*

*gradual process from land distribution to collective farms should be outlined; in industry, the Five Year Plan and Soviet help.*

*The 100 Flowers Campaign should be covered in brief. The Great Leap Forward should be covered in more detail, particularly the development of commune and assessment of the GLF. Finally, a brief outline of the Cultural Revolution and its impact on China. Estimate of Mao should be short and to the point.*

- (ii) Ghana: democracy, dictatorship and military government (1957-69).

*Brief background to independence, Nkrumah's role, reasons for his overthrow; coup of 1966.*

- (iii) Kenya: conflict and independence (1947 – 1969).

*Background: conflict over independence and role of Kenyatta.*

**9. Cold War 1945-91– origin, course, end and impact**

- (i) Origins of the Cold War: End of wartime unity; Yalta and Potsdam Conferences; Truman Doctrine and Marshall Plan; Molotov Plan, COMECON and Cominform. The rift widens - Soviet expansion in Eastern Europe (1945-1948) including the communist coup in Czechoslovakia.

*The main points raised at the two post-War Conferences as well as the major points of differences should be explained. A general account of the Soviet expansion in East Europe until 1948 and the major causes of the Cold War should be done in this context.*

- (ii) The Cold War expands: Berlin Blockade; NATO; division of Germany; "thaw" in the Cold War (1953-59) - how partial was it? Warsaw Pact; the Vietnam War (1954-75); crisis in east-west relations (1960-62); detente (1970s).

*Each of the events referred to above should be done in some detail; the two phases of the Vietnam War, the French and the US involvement and escalation after the Tonkin Gulf incident to be done. In the 1960-62 period, the U-2 affair and the Berlin Wall incident should be mentioned; the Cuban*



*Missile crisis should be done in detail – the easing of tension can be done as a result of the crisis. Only the outline of the reasons for détente and how it worked should be done.*

- (iii) Breakup of the USSR & changes in Eastern Europe – USSR, Germany, Poland, Czechoslovakia.

*Reasons for collapse of USSR: economic failure; Gorbachev's policies (1985): Glasnost and Perestroika.*

*Role played by Ronald Reagan and George H. W. Bush (with reference to the Cold War).*

*Fall of communism in East Europe in the following countries to be touched upon: Poland, Germany and Czechoslovakia.*

## 10. Protest Movements

Civil Rights Movement, anti-Apartheid Movement; Feminist Movement.

- (i) *Racial problems and civil rights in USA in the 1950s, 1960s and 1970s: Racial discrimination, change in the government's attitude, campaign for equal rights (Dr. Martin Luther King's role).*

- (ii) *Anti-Apartheid Movement in South Africa (1948-1994): main features of Apartheid, opposition to Apartheid (Dr Nelson Mandela's role), transition to black majority rule and the end of Apartheid.*

- (iii) *Second Wave Feminist Movement in USA (early 1960s – early 1980's): reasons for its origin (the impact of the Presidential Commission, Betty Friedan's book and the Civil Rights Movement; Equal Pay Act of 1963 – its implications for American women, successive measures taken by Johnson (Civil Rights Act of 1964), role of National Organisation for Women (NOW) and its campaign for the Equal Rights Amendment (ERA). Socio-cultural impact of the Movement to be mentioned briefly.*

## 11. Middle East: Israeli-Palestine conflict (1916-1993)

- (i) Post War conflict in Palestine after World War I, till the formation of the state of Israel. *Aims of Arab nationalism and Zionism. Impact of World War I: the conflicting promises made by the British to the*

*Arabs and the Jews: Husain-MacMahon correspondence, the Sykes-Picot Agreement and the Balfour Declaration. All these need to be understood clearly. A general outline of events in the British Mandate of Palestine from 1919 to the Arab Revolt of the late 1930s (the increased immigration of Jews and the resultant conflict).*

*The impact of World War II and the intensification of the conflict against Britain's decision to withdraw – the UNO's plan. Creation of Israel and the War of Liberation (a chronological account should suffice here).*

- (ii) The Arab-Israeli Wars from 1948 to Camp David Accord (1979).

*The following conflicts should be studied – First Arab- Israeli Conflict (1948-1949), the Suez Crisis (1956), the Six Day War (1967), the Yom Kippur War (1973), Sadat and the Camp David Accord (1979). For each of these events, the causes and results should be studied in detail. Events to be covered briefly.*

*The origin and formation of the PLO.*

- (iii) Oslo Peace Accords (1993).

*Intifada and the change in attitude of Israel and the PLO leading to the Oslo Peace Accords: assessment of the main features: why it failed to bring peace.*

## PAPER II (PROJECT WORK)

- 20 MARKS

Candidates will be required to undertake **one** project which **may** be any one of the following:

1. A case study.
2. A field visit/ investigation.
3. A local history.
4. Interview/oral evidence.
5. Book review/ film review/ posters/ newspapers/ advertisements/ cartoons and art.

The project must not be based primarily on the syllabus; students must be encouraged to produce original, creative and insightful perspectives on an allied aspect of the topic.

For example, if the theme is economic development in India, the project could be on a 5-year plan. However, it would have to give the historical perspective and impact.

**The written outcome of the project, in the form of a 2000-word essay, should be structured as given below:**

- A. The research question
- B. Abstract: it must contain the following information:-
  - Reason for choosing the topic
  - Methods and material to be used in the investigation
  - Hypothesis: the conclusion the student is hoping to draw.
- C. Main essay: it must follow the structure given below:-
  - Background and context – to be discussed very briefly
  - Explanation of the theme and specific issue of the research question in the context of the background given above
  - Interpretation, Analysis and Critical Evaluation of a range of evidence: the research material gathered by the student
  - Conclusion – whether hypothesis stands or not
  - Bibliography – a list of all material referred to in the essay, including print, electronic, oral & audio-visual material, referenced correctly, in a standard format
  - Appendix – optional, only if it is crucial for the better understanding of the project essay.

**List of suggested Projects:**

1. Martin Luther King.
2. The West Asian radical organisations – ideologies, methodologies, acts and impact.
3. Protests Movements – a detailed study on any one – political ideologies, civil rights, women, workers, caste, environment.
4. Nelson Mandela.
5. Karl Marx – Wealth of Nations – Its influence on the Russian Revolution.
6. Mao Zedong and the Chinese Communist Revolution.
7. Collapse of the Russian and Chinese Communism.
8. Strands in the late 20<sup>th</sup> Century - military and economic organisations.

9. UN – Peacekeeping actions and Weaknesses.
10. The Cultural Movement (1968).
11. Trends in India’s Foreign Policy – dynamics and the changing trends.
12. Theatres of World War II - changes in warfare.

**Some of the suggested projects have been exemplified in greater detail below:**

1. Martin Luther King
  - A. The research question – How far was Martin Luther King successful in the achievement of his aims through non-violent methods?
  - B. Abstract: it must contain the following information:-
    - (i) Reason for choosing the topic – to understand the value of no-violence as an effective means of protest.
    - (ii) Material and methods to be used in the investigation – Materials: may include books, magazine articles (both print and electronic), Martin Luther King’s famous speech, films like Mississippi Burning. Method: reading/ viewing, taking notes for analysis, and evaluation.
    - (iii) Hypothesis: the conclusion the student is hoping to draw.
  - C. Main essay: it must follow the structure given below:
    - Background and context – Martin Luther King’s personal background and his involvement in the civil rights movement.
    - Explanation of the theme and specific issue of the research question in the context of the background given above – the different aspects of the research question must be dealt with individually and in detail: Martin Luther King’s aims, methods used by him, how far successful.
    - Interpretation, Analysis and Critical Evaluation of a range of evidence: the research material gathered by the student – the various research material may be analysed and interpreted by the student to fit his/ her hypothesis; may also include comparison of the different sources to evaluate their usefulness.
    - Conclusion – whether hypothesis stands or not.

- Bibliography – a list of all material referred to in the essay, including print, electronic, oral & audio-visual material, referenced correctly, in a standard format.
  - Appendix – optional, only if it is crucial for the better understanding of the project essay.
2. The West Asian radical organisations – ideologies, methodologies, acts and impact.
- A. The research question – What methods were used in the period 1948-1979 by the PLO to achieve a homeland for Palestinians and with what effect?
- B. Abstract: it must contain the following information:-
- (i) Reason for choosing the topic – to understand the impact of radical political organizations on the search for peace in West Asia.
  - (ii) Methods and material to be used in the investigation – Materials: may include books, magazine articles (both print and electronic), films like Chronicle of A Disappearance (1996). Method: reading/ viewing, taking notes for analysis, and evaluation.
  - (iii) Hypothesis: the conclusion the student is hoping to draw.
- C. Main essay: it must follow the structure given below:-
- Background and context – to be discussed very briefly: West Asia, the settlement of Jews in Israel, the question of Palestinians and the Birth of the PLO.
  - Explanation of the theme and specific issue of the research question in the context of the background given above – the different aspects of the research question must be dealt with individually and in detail: the role played by the PLO, its impact, its success/ failures.
  - Interpretation, Analysis and Critical Evaluation of a range of evidence: the research material gathered by the student – the various research material may be analysed and interpreted by the student to fit his/ her hypothesis; may also include comparison of the different sources to evaluate their usefulness.
- Conclusion – whether hypothesis stands or not.
  - Bibliography – a list of all material referred to in the essay, including print, electronic, oral & audio-visual material, referenced correctly, in a standard format.
  - Appendix – optional, only if it is crucial for the better understanding of the project essay.
3. Protests Movements – a detailed study on any one - political ideologies, civil rights, women, workers, caste, environment.
- A. The research question – What impact did the Greenpeace movement have on the general improvement of the world environment in the 1970s and 1980s?
- B. Abstract: it must contain the following information:-
- (i) Reason for choosing the topic – to understand the connection between global politics and environmental issues
  - (ii) Methods and material to be used in the investigation – Materials: may include books, magazine articles (both print and electronic), films like Free Willy (1993) and Soylent Green (1973)
  - (iii) Hypothesis: the conclusion the student is hoping to draw – that people have become much more conscious of the importance of the natural environment.
- C. Main essay: it must follow the structure given below:-
- Background and context – How the Greenpeace movement was born and the context of world politics at that time that adversely affected the environment.
  - Explanation of the theme and specific issue of the research question in the context of the background given above - the different aspects of the research question must be dealt with individually and in detail: Aims of the Greenpeace movement, its organization and structure, its activities in the 1970s and 1980s; its relationship and issues/ conflicts with national governments.

- Interpretation, Analysis and Critical Evaluation of a range of evidence: the research material gathered by the student – the various research material may be analysed and interpreted by the student to fit his/ her hypothesis; may also include comparison of the different sources to evaluate their usefulness.
- Conclusion – whether hypothesis stands or not.
- Bibliography – a list of all material referred to in the essay, including print, electronic, oral & audio-visual material, referenced correctly, in a standard format.
- Appendix – optional, only if it is crucial for the better understanding of the project essay.

**The Project will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

**Assessment of Project Work will be done as follows:**

1.	Internal Evaluation by Teacher	10 Marks
2.	Evaluation by Visiting Examiner	10 Marks
<b>TOTAL</b>		<b>20 Marks</b>

**Internal Evaluation by the Teacher:**

Assessment objective	Criteria	Marks
1. Process	Candidate should be able to:  Identify the topic. Plan and detail a research project.  Select and use appropriate research methods.	3

2. Understanding, application of knowledge and Analysis	Candidate should be able to: Explain issues and themes clearly and in context. Interpret, analyse and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statement.	4
3. Presentation	Overall format, referencing (footnotes &/or bibliography), within word limit of 2000 words, title page, header/footer, etc.	3
<b>TOTAL</b>		<b>10</b>

**Evaluation by the Visiting Examiner:**

Assessment objective	Criteria	Marks
1. Choice of Technique/ Detailed procedure & Presentation	Overall format, referencing (footnotes &/or bibliography), title page, header/footer, etc.	4
2. Analysis and evaluation	Candidates should be able to: Interpret, analyze and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statement.	3
3. Viva	Range of questions based on the project only.	3
<b>TOTAL</b>		<b>10</b>

### **GUIDELINES FOR TEACHERS:**

1. It must be emphasized that the **process** of doing the project is as important as the finished product.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to make out a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference materials could be suggested and even put up on the library notice board for guidance of the students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks must be awarded for content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.

# POLITICAL SCIENCE (852)

## Aims:

1. To enable students to gain an understanding of basic concepts in Political Science.
2. To facilitate acquisition of knowledge and understanding of the practices of governance.
3. To develop logical reasoning, research and application skills.
4. To create awareness of rights and duties and to sensitise students towards social concerns.
5. To expose students to divergent views and encourage them to develop their own world view.

## CLASS XI

*There will be two papers in the subject:*

*Paper I: Theory 3 hours ----- 80 marks*

*Paper II: Project Work -----20 marks*

### PAPER I (THEORY) – 80 Marks

***Part I (20 marks)*** will consist of ***compulsory*** short answer questions, testing knowledge, application and skills relating to elementary/ fundamental aspects of the entire syllabus.

***Part II (60 marks)*** will be divided into ***two*** sections A & B. Candidates will be required to answer ***three*** questions out of ***five*** from Section A and ***two*** questions out of ***three*** from Section B. Each question in this part shall carry ***12 marks***.

### SECTION A

#### Political Theory

#### 1. Introduction to Political Science

- (i) Meaning of Political Science; Scope of contemporary Political Science: Political Theory, Comparative Politics, International Relations, Public Administration and Political Economy. Nature of Political Science.

*Meaning of Political Science; Scope of contemporary Political Science with reference to Political Theory, Comparative Politics, International Relations, Public Administration and Political Economy. Nature of Political Science - Is Political Science a Science?*

- (ii) Fundamental Concepts

State and its elements; Difference between State and Society, State and Association,

State and Government, State and Nation; Nationality.

*Definition of State and elements of the State: (a) Population (b) Territory (c) Government (d) Sovereignty. Definition of Society; Association; Nation and nationality. Differences between – State and Society; State and Association; State and Government; State and Nation.*

#### 2. The Origin of the State

Divine Origin Theory; the Social Contract Theory (Hobbes, Locke, Rousseau); the Evolutionary Theory.

*Various theories of the origin of State:*

*Divine Theory: brief history of this theory, divine rights of the kings - examples from modern monarchical states like England and Bhutan. Critical evaluation of the theory.*

*The Social Contract theory: Views of Hobbes, Locke and Rousseau; Critical evaluation of the theory.*

*Evolutionary Theory: factors for the growth of this theory such as kinship, religion, economic factors, wars and conflicts and the need for political power.*

#### 3. Political Ideologies

Liberalism, Socialism; Communism and Fascism.

*Liberalism, Socialism; Communism and Fascism: Meaning, features with reference to the purpose of the State. Critical evaluation of each ideology.*

#### 4. Sovereignty

Meaning, kinds and characteristics. A historical analysis and contemporary issues.

*Meaning, definition and characteristics. Kinds: Titular and Real, Legal and Political; de-jure and de-facto Sovereign, Popular Sovereignty. Is Sovereignty absolute and indivisible? Brief study of Austin's Theory and Pluralistic view of Sovereignty with reference to Laski and MacIver. Sovereignty in a globalised World: the role of non-state actors.*

## 5. Law

Meaning; Sources and Kinds of Law.

*Meaning, definition of law. Sources - Customs, Usages, Religion, Judicial Decisions, Scientific Commentaries, Equity, Legislation. Kinds of law – definition and examples of Municipal, National, Constitutional and International Law, Statute Law, Ordinances.*

## 6. Liberty

Meaning; Dimensions and kinds of Liberty; Relationship between Liberty and Law; safeguards of liberty.

*Definition and meaning of Liberty; Dimensions - negative and positive; kinds of Liberty - Civil, Political and Economic Liberty. Relationship between Liberty and Law: Does Law help or hinder Liberty? Safeguards of Liberty - fundamental rights. Separation of judiciary from executive, well-knit party system, economic justice for all, free press and media, vigilance by the people.*

## 7. Equality

Meaning and kinds of Equality; Relationship between Equality and Liberty.

*Meaning and kinds of Equality– legal, social, political and economic; relationship between Equality and Liberty: How do they complement each other?*

## 8. Justice

Meaning, Kinds and Contemporary theories.

*Meaning of Justice; kinds: Legal, Social, Economic and Political. Theories of Justice – John Rawls and Amartya Sen.*

## SECTION B

### Contemporary International Relations

#### 9. End of Cold War and its impact on the World Order

Disintegration of the Soviet Union and its impact on the World Order.

*Meaning of Cold War. Impact of disintegration of the Soviet Union on the World Order – end of Cold War confrontation, change of power equations in world politics, emergence of new countries. India's relations with Russia after Cold War (after 1991).*

#### 10. Unipolar World

U.S. unilateralism: case studies of U.S. intervention in Iraq and Afghanistan.

*Meaning of unilateralism.*

*Case studies of the following (causes, main events and consequences):*

*Iraq - Operation Desert Storm, Operation Iraqi Freedom; Afghanistan - Operation Enduring Freedom;*

*India's relations with USA after 1991.*

#### 11. Regional Cooperation

ASEAN and the European Union.

*Aims, achievements and challenges.*

#### 12. The Non-Aligned Movement

Relevance of Non-Aligned Movement.

*Meaning of Non-Aligned Movement (NAM); Relevance of NAM in the contemporary World. Role of India in NAM.*

### PAPER II (PROJECT WORK) – 20 MARKS

Candidates will be required to undertake **one** project which **may** be any one of the following:

- (i) A case study.
- (ii) Survey study with a questionnaire.
- (iii) Research based project with in depth analysis.
- (iv) Local/ national/ global political issue.
- (v) Book review/ film review/ documentaries/ posters/ newspapers/ advertisements/ cartoons and art.

The project must not be based primarily on the syllabus; students must be encouraged to produce original, creative and insightful perspectives on an allied aspect of the topic.

For example, if the theme is Fundamental Rights, the project could deal with violation, protection, court verdicts, Public Interest Litigations (PILs), etc. related to socially relevant issues.

### EVALUATION CRITERIA:

Mark allocation for the Project will be as follows:

S. No.	Assessment objective	Criteria	Marks
1.	Process	Candidate should be able to:  Identify the topic. Plan and detail a research project.  Select and use appropriate research methods.	5
2.	Understanding, application of knowledge and Analysis	Candidate should be able to:  Explain issues and themes clearly and in context.  Interpret, analyse and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statement.	5
3.	Presentation	Overall format, referencing (footnotes &/or bibliography), within word limit of 2000 words, title page, header/footer, etc.	5
4.	Viva	Range of questions based on the project only.	5
<b>TOTAL</b>			<b>20</b>

### List of suggested topics for Project Work:

1. “The Kingdom of Freedom begins where the Kingdom of Necessity ends”.
2. Right to Freedom and role of Media.
3. The Right to Information – ensuring political accountability.
4. Citing relevant examples, discuss the relative importance of negative and positive liberty in the Indian context.
5. India’s response to ASEAN as a dialogue partner.
6. Relevance of SAARC as a forum of regional cooperation.
7. U.S. dominance in World politics in the Post Cold War era.
8. India’s role in Non-Aligned Movement.
9. Civil Society Movements - Role and participation in India.
10. Relevance of the United Nations in a Unipolar World.

### GUIDELINES FOR TEACHERS:

1. It must be emphasized that the process of doing the project is as important as the final project.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to make out a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference material could be suggested by the teachers and made available to the students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks must be awarded for content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.



## CLASS XII

There will be **two** papers in the subject:

Paper I: Theory 3 hours ----- 80 marks

Paper II: Project Work ----- 20 marks

### PAPER I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

**Part II (60 marks)** will be divided into **two** sections A & B. Candidates will be required to answer **three** questions out of **five** from Section A and **two** questions out of **three** from Section B. Each question in this part shall carry **12 marks**.

### SECTION A

#### Constitution and Government

##### 1. Forms of Government

Totalitarian and Authoritarian States, Liberal Democratic State, Unitary and Federal States, Parliamentary and Presidential forms of government.

*Meaning and features of Totalitarian State, Authoritarian State and Liberal Democratic State.*

*Comparison between Totalitarian and Authoritarian States. Historic and contemporary examples of each.*

*Meaning and features of Unitary and Federal States with reference to U.K. as a Unitary state, U.S.A. as a Federal State and India as a federal state with subsidiary unitary features, comparison between unitary and federal state.*

*Meaning and features of Parliamentary and Presidential forms of government (U.K. and U.S.A.). Comparison between Parliamentary and Presidential forms of government.*

##### 2. Constitution

Meaning; kinds of Constitutions: Written and Unwritten, Rigid and Flexible, Enacted and Evolved: merits and demerits. Amending procedures; Conventions.

*Meaning; kinds: Written and Unwritten, Rigid and Flexible, Enacted and Evolved: merits,*

*demerits of each. Is the difference between Written and Unwritten, Rigid and Flexible a real one?*

*Amending procedures of the Constitutions of U.K., U.S.A and India.*

*Conventions: meaning and examples with reference to U.K., U.S.A. and India. The importance of Conventions in U.K.*

##### 3. Franchise and Representation

Universal Adult Franchise; Methods of Election; Constituency; Minority Representation. Political Parties; Party System.

*Universal Adult Franchise - meaning, reasons for widespread acceptance.*

*Methods of Election: Direct and Indirect – meaning with examples.*

*Meaning of Constituency, Single member and Multi-member with examples.*

*First Past the Post System – meaning, merits and demerits.*

*Minority Representation - meaning, rationale (Why is it important for minorities to be represented properly).*

*Methods of Minority Representation: Proportional Representation (List system and single transferable vote system), Cumulative Vote System, Nomination and Reservation.*

*Political Parties - meaning, definition and functions. Kinds – Single party, Bi-party, Multi-party system - meaning, merits and demerits.*

#### Organs of the Government

##### 4. The Legislature

Functions of Legislature; Unicameral and Bicameral legislatures. The legislature in India and U.S.A. - a comparative study.

*Meaning and functions of Legislature. Meaning of Unicameral and Bi-cameral legislature. The legislatures in India and U.S.A.- Composition (strength, method of election and tenure) and functions: legislative, constituent, executive (ways in which the legislature controls the executive), judicial, electoral and financial.*

*Composition and powers of the House of Representatives and the Senate, Lok Sabha and Rajya Sabha (including special powers).*

*Unique powers of the Senate, why is the Senate considered the world's most powerful second chamber?*

*Comparison of the Rajya Sabha and the U.S. Senate; Lok Sabha with the U.S. House of Representatives.*

## **5. The Executive**

Functions; The Civil Services. Difference between the Political Executive and the Permanent Executive. Political Executive in India and U.S.A. - a comparative study.

*Meaning, and functions of the Executive. Meaning and role of Civil Services.*

*Difference between the Political and Permanent Executive in India. Political Executive in India and U.S.A. - a comparative study. Powers and functions of executive heads of India (President and Prime Minister), and U.S.A. (President). Constitutional limitations on the powers of the President of the USA.*

*Changing role of the Indian Prime Minister with reference to the past two decades.*

## **6. The Judiciary**

Meaning and functions of Judiciary. Conditions of Independence of Judiciary. Judiciary in India and U.S.A. - a comparative study. Judicial Review.

*Meaning and functions of judiciary; conditions of independence of judiciary with reference to India and U.S.A. The Judiciary in India and U.S.A. – composition and powers of Indian Supreme Court and American Supreme Court. Judicial Review – meaning, principles (maxims) and critical evaluation with special reference to U.S.A. and India. Meaning of Judicial Activism and Judicial Restraint. Comparative study of Indian and US Supreme Courts - Which is most powerful and Why?*

## **SECTION B Indian Democracy**

### **7. Indian Constitution**

#### **(i) Preamble**

*Preamble and its importance. Meaning of the key words contained in the Preamble.*

#### **(ii) Salient features of the Indian Constitution.**

*Written and Comprehensive; a Constitution drawn from several sources; Federal structure with Unitary spirit; Partly rigid and Partly flexible; Fundamental Rights and Duties; Directive Principles of State Policy; Parliamentary form of Government; Single Citizenship; Bi-cameral legislature; Universal Adult Franchise; Single Integrated and Independent Judiciary; Judicial Review; Emergency powers; Special provisions for Schedule castes and Schedule tribes.*

### **8. Fundamental Rights and Directive Principles**

Fundamental Rights and Directive Principles of State Policy.

*Fundamental Rights: meaning and importance of Fundamental Rights; detailed study of all Fundamental Rights in India.*

*Directive Principles of State Policy: meaning and purpose; classification, importance and implementation.*

*Relationship between Fundamental Rights and Directive Principles of State Policy.*

### **9. Local self-government**

73<sup>rd</sup> and 74<sup>th</sup> Constitutional Amendment Acts.

*Key features of the 73<sup>rd</sup> and 74<sup>th</sup> Amendments. 11<sup>th</sup> and 12<sup>th</sup> schedules in brief.*

*Three tier systems of Panchayati Raj: Rural and Urban local bodies - their composition. Challenges and solutions.*

## 10. Democracy in India – a perspective of the challenges faced

- (i) Challenges faced by the Indian Democracy: Caste, Communalism, Regionalism and Political Violence. Strengthening Indian Democracy.

*Caste: meaning, role of caste in Indian Politics.*

*Communalism: meaning and effects on the functioning of Indian democracy.*

*Regionalism: meaning and causes; kinds of regional aspirations (language issues, sons-of-the-soil policies, river water disputes, demand for new states, secessionist demands); responding to regionalism.*

*Political Violence: meaning, forms, causes and effects.*

*Strengthening Indian Democracy: measures to overcome the challenges faced by Indian Democracy.*

### PAPER II (PROJECT WORK) – 20 MARKS

Candidates will be required to undertake **one** project which **may** be any one of the following:

- (i) A case study.
- (ii) Survey study with a questionnaire.
- (iii) Research based project with in-depth analysis.
- (iv) Local/ national/ global political issue.
- (v) Book review/ film review/ documentaries/ posters/ newspapers/ advertisements/ cartoons and art.

The project must not be based primarily on the syllabus; students must be encouraged to produce original, creative and insightful perspectives on an allied aspect of the topic.

For example, if the theme is Fundamental Rights, the project could deal with violation, protection, court verdicts, Public Interest Litigations (PILs), etc. related to socially relevant issues.

**The project will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Assessment of Project Work will be done as follows:

1.	Internal Evaluation by Teacher	10 Marks
2.	Evaluation by Visiting Examiner	10 Marks
<b>TOTAL</b>		<b>20 Marks</b>

### Internal Evaluation by Teacher

S. No.	Assessment objective	Criteria	Marks
1.	Process	Candidates should be able to:  Identify the topic. Plan and detail a research project.  Select and use appropriate research methods.	3
2.	Understanding application of knowledge and Analysis	Candidates should be able to:  Explain issues and themes clearly and in context.  Interpret, analyse and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statement.	4
3.	Presentation	Overall format, referencing (footnotes &/or bibliography), within word limit of 2000 words, title page, header/footer, etc.	3
<b>TOTAL</b>			<b>10</b>

### Evaluation by the Visiting Examiner

S. No.	Assessment objective	Criteria	Marks
1.	Choice of Technique/ Detailed procedure & Presentation	Overall format, referencing (footnotes &/or bibliography), title page, header/footer, etc.	4
2.	Analysis and evaluation	Candidate should be able to: Interpret, analyze and evaluate critically a range of evidence to present reasoned, substantiated arguments/ statement.	3
3.	Viva	Range of questions based on the project only.	3
<b>TOTAL</b>			<b>10</b>

### List of suggested topics for Project Work:

Given below is a list of suggested topics for Project work, along with guidelines.

- Judicial Activism – two case studies in which the Judiciary has safeguarded the environment or human rights.
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - Define Judicial Activism and the need for Judiciary to intervene in the work of Legislature and Executive and other matters of social concerns.
  - Positive role played by Judiciary in this direction to be highlighted with the help of two case studies based on environmental protection or safeguarding human rights.
  - Student's perception of the concept.
  - Valid suggestions for reforms in Judiciary.

- Public accountability of Civil Servants in India – Is it a myth or a reality?
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - Meaning of Public accountability of Civil Servants to be explained.
  - Positive and crucial role of public servants in a democracy.
  - Loopholes in the existing bureaucratic set up.
  - Inferences can be drawn about Public accountability being a myth or reality from various sources like print/electronic media, film review, documentaries.

- Party System in India – changing phases.
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - A brief timeline of Party Systems since independence to be prepared.

- Strengths and limitations of different systems to be highlighted.
- Success and failure of various systems to be analysed with reference to the role of regional parties in coalition era.
- Few examples to be explained with the help of statistical information.
- Student's vision of rapidly evolving Party system in India.

- Examine one Supreme Court case dealing with Fundamental Rights. Identify the issues of the case and analyse the final ruling.
  - Reason for selection of the topic
  - Framing the Research Question.
  - Hypothesis.
  - Nature and reasons of violation of Fundamental Rights to be explained.
  - A case study of violation and protection of Fundamental Rights in the light of the ruling given by the apex court to be analysed.
  - Remedial steps to be taken to prevent this problem to be suggested.

5. Role of Local Self Government institutions in women empowerment.
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - Need for women empowerment to be explained with reference to a few examples.
  - Positive role played by local self-governments to be stated.
  - Collection of data based on statistics and analysis.
  - The project could be in the form of a case study for example - a film review, book review, advertisements, T.V. serials, documentaries, newspaper articles, journals.
  - Student's suggestions for more active participation of women in Indian electoral politics.
6. Explore the controversies around the development of a Uniform Civil Code mentioned in the Directive Principles.
  - Reason for selection of the topic.
  - Framing the Research Question
  - Hypothesis
  - Clarification of the concept of Uniform Civil Code with instances from world constitutions.
  - Need for a Uniform Civil Code with reference to Constituent Assembly Debates, historical perspective (parliamentary debates and judicial pronouncements), the present socio-political scenario and the stand of various political parties.
  - Controversies and reasons for non-adoption.
  - Student's view point and position on the issue.

Alternately this project could also be undertaken survey method or any other method.
7. Identify and explain the electoral reforms that are urgently needed in India.
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - Define electoral reforms.
  - Urgency for electoral reforms.
  - Efforts made in the past.
8. Discrimination faced by a girl child.
  - Parliamentary debates on this issue.
  - Role of the Election Commission.
  - Stand of various political parties.
  - Judicial pronouncements.
  - Student's observations.
9. Right to Education: To what extent has it benefited the slum children?
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - Constitutional provisions.
  - Parliamentary debates leading to the enactment of the right.
  - A case study of a slum area based on a survey.
  - Student's inferences.
10. Role of National Human Rights Commission in safeguarding the rights of the under-privileged.
  - Reason for selection of the topic.
  - Framing the Research Question.
  - Hypothesis.
  - United Nations Universal Declaration of Human Rights (1948).
  - Constitutional provisions.
  - Formation of National Human Rights Commission.
  - Its composition and functions.
  - Identifying the under-privileged and understanding their plight.
  - Efforts made by the NHRC (a minimum of two case studies).
  - Student's viewpoint.

### **GUIDELINES FOR TEACHERS:**

1. It must be emphasized that the process of doing the project is as important as the final project.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to make out a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference material could be suggested by the teachers and made available to the students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks to be awarded for the content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.

# GEOGRAPHY (853)

## Aims

1. To enable candidates to acquire knowledge (information) and to develop an understanding of facts, terms, symbols concepts, principles, generalizations, hypotheses, problems, trends, processes and methods of Geography at the national and global level.
2. To apply the knowledge of the principles of Physical Geography in explaining the causes and consequences of natural hazards and suggest ways of coping with them through sustainable development.
3. To develop skills of drawing maps, surveying, and drawing statistical diagrams and thematic maps.
4. To develop an interest in Geography.

## CLASS XI

There will be **two** papers in the subject:

**Paper I** – Theory (3 hours) ....70 marks

**Paper II** – Practical and Project Work ...30 marks

### PAPER I: THEORY (70 Marks)

There will be one Theory paper of **three** hours duration divided into **two** parts:

**Part I (30 marks)** will be **compulsory** and will consist of Section A and Section B.

**Section A** will include **compulsory** short answer questions testing knowledge, application and skills related to elementary/fundamental aspects of the entire syllabus.

**Section B** will consist of one question on **map work**.

**Part II (40 marks)** will consist of **seven** questions. Candidates will be required to answer **four** out of **seven** questions. Each question in this part shall carry **10 marks**.

## GEOGRAPHY AS A DISCIPLINE

### 1. Geography - its interdisciplinary approach and future prospects

Geography as an integrating discipline. Physical Geography and Natural Sciences; Geography and Social Sciences.

Branches of Geography:

- (i) **Systematic approach:** Physical Geography (Geomorphology, Climatology, Hydrology); Human Geography (Historical, Social, Population and Settlement, Economic, Political).

– The conceptual and intellectual ideas of a number of new approaches to contemporary human geography should be examined to understand the strengths and limitations of each approach within the context of Human Geography and Social Sciences.

- (ii) **Regional approach:** Regional/ Area Studies, Regional Planning, Regional Development.

Future prospects of Geography to be discussed:

- In the area of GPS, GIS, Remote Sensing for resource identification.
- Applied geography in town and country planning, environment management and law, cartography and mapping, geography education, map analysis, travel and tourism (to be taught only for the sake of awareness, not for testing).

## PRINCIPLES OF PHYSICAL GEOGRAPHY

### 2. Formation of the Earth

Theories of formation; Methods of measuring age of the earth; Structure and Composition; Rocks.

- (i) **Theories of formation of the earth: the Big Bang theory..**
- (ii) **Methods of measuring age of the earth: Tidal force, Sedimentation, Rate of Erosion, Salinity of the Ocean, Radioactivity – a brief understanding.**

(iii) *Structure and composition of the earth's interior: crust, mantle, core; their properties - temperature, pressure, thickness. Sources of information – direct and indirect; seismic waves, their behaviour and inferences.*

(iv) *Rocks: Definition of rocks and minerals. The mineral groups responsible for different rocks formed on the earth: silicates, carbonates, sulphides, metals.*

*Classification of rocks by origin: igneous, metamorphic and sedimentary rocks – their distribution in India; characteristics, types, economic importance.*

*The rock cycle.*

### 3. Changing Face of the Earth

#### Landforms and Processes of Gradation

(i) *Endogenous processes: theory of plate tectonics and the process of drifting continents, theory of Isostasy by Pratt and A. Holmes.*

*Definition of endogenetic force, difference between slow and sudden forces, vertical and horizontal forces and their effects. Folding and Faulting – types, Sea floor spreading, continental drifting and isostasy.*

(ii) *Landforms – mountains, plateaus and plains and their types.*

*Meaning and differentiation between the three main landforms of the earth.*

*Classification of mountains on the basis of their origin or mode of formation: fold, block, volcanic and residual with examples from the world.*

*Classification of plateaus on the basis of their situation: intermontane, piedmont and continental with examples from the world.*

*Classification of Plains on the basis of formation: structural, erosional and depositional with examples from the world.*

(iii) *Vulcanicity – materials and processes. Major volcanic forms.*

*Explanation of how volcanoes are formed; identification of the type of volcano; recognition of the properties of volcanic materials; explanation of why volcanoes are more in the areas of converging plates.*

(iv) *Earthquakes.*

*Origin of earthquakes, waves and their behaviour, hypocentre (focus), epicentre; their causes and distribution; effects; isoseismal and homoseismal lines, sea quakes, tsunamis; measuring earthquakes and their intensity.*

*Studying the effects of earthquakes on a country like Japan.*

(v) *Exogenetic process and associated landforms.*

*Weathering and gradation – difference between the two. Role of weathering in gradation. Different types of weathering.*

(vi) *Soil.*

*The factors affecting soil formation; soil profile; physical and chemical properties, distribution and characteristics of soils in the world - zonal, azonal and intrazonal– only broad characteristics related to Indian soils to be done (detailed distribution **not required**).*

*Alluvial, red, yellow, black and laterite soils in India and the problems related to their management.*

(vii) *Fluvial processes and associated landforms.*

*Work of rivers - concept of baselevel; processes of erosion, transportation and deposition. Types of erosion - headward, vertical, lateral; transportation mode and deposition.*

*Landforms made by the river - V shaped valley, gorges, rapids, waterfalls, alluvial fans, levees, floodplains, meanders - river cliff, slip-off slope; braided channels, oxbow lakes, deltas – delta plains.*

*Development of river valleys, drainage patterns. **Diagrams and examples from India with photographs.***

(viii) *Aeolian processes and associated landforms.*

*Process of wind erosion – abrasion, attrition, deflation. Ideal conditions for erosion in hot deserts; landforms resulting from erosion - deflation hollows, pedestal rocks, yardangs, desert pavement; landforms resulting from deposition - sand dunes and their types, loess. **Diagrams and examples from India and Asia.***



(ix) Glacial processes and associated landforms.

*Continental and mountain or valley glaciers, processes of glacial erosion – plucking, abrasion, attrition; erosional features, e.g. cirque and its components, U shaped and hanging valleys, roche moutonnes, crag and tail, depositional formations, moraines of various types. Some Indian glaciers - Siachen, Gangotri, Baltoro. Diagrams and examples from India.*

(x) Work of ground water and associated landforms. Water Conservation.

*Definition of ground water, water table, aquifers, springs. Process of erosion by groundwater solution, corrosion. Features formed by underground water (karst topography) – sink holes, dolines, caves, caverns, karst lakes, depositional features – stalactites, stalagmites, cave pillars, dripstones: their formation. Diagrams and examples from India and Australia.*

*Emerging water problems and conservation of water resources.*

(xi) Marine processes and associated landforms.

*Erosional process of sea waves – abrasion, attrition, solution and hydraulic action; coastline and shoreline, erosional features; sea cliffs, sea caves, sea arch, headland inlet, stacks and depositional landforms, e.g. - bays, bars and lagoons; Coral reefs: types – fringing, barrier and atolls; submerged and emergent coastlines. Diagrams and examples from India, Australia and West Europe (wherever relevant).*

**Note:** For topics (viii) to (xii) only diagram or photograph based questions will be asked. Photograph based information should be made use of to emphasize the different processes of gradation.

#### 4. Atmosphere

(i) Composition and structure of atmosphere.

*Layers of the atmosphere: troposphere, stratosphere, ozonosphere, mesosphere, ionosphere; their height; composition; special characteristics of each layer; ozone depletion.*

(ii) Atmospheric temperature.

*Heating and cooling of the atmosphere, radiation, conduction, convection. Insolation and factors influencing it – angle of sun's rays, duration of day, transparency of atmosphere. Heat budget i.e. balance between insolation and terrestrial radiation-areas of surplus and deficit heat in different latitudes resulting in latitudinal heat balance.*

*Factors controlling its horizontal and vertical distribution, temperature anomalies and their nature. Isotherms: their characteristics; isotherm maps of the world in July and January. Reasons for the variations in temperature. **Practical work on temperature measurement and graphs to show variations in temperature of one or more cities of India.***

(iii) Atmospheric Pressure.

*Its horizontal and vertical distribution, factors affecting the distribution, characteristics of isobars on world maps for July and January. Patterns and the causes for the distribution of isobars.*

*Pressure belts and winds – types of winds, air masses and atmospheric disturbances, cyclones of temperate and tropical areas; anticyclones – their types and associated weather. World map showing major paths of cyclones. Jet Streams – concepts to be introduced with reference to India.*

**Practical work on pressure measurement.**

(iv) Atmospheric Moisture.

*Processes of evaporation, condensation and precipitation; relative and absolute humidity; forms of condensation - cloud, fog, dew, frost; precipitation – its forms: snow, hail, rain; types of rainfall: orographic, cyclonic, convectional. Monsoons – origin and factors that affect. Examples from different parts of the world.*

**Practical work on measuring rainfall and use of bar graphs to show variations in rainfall in one or more cities of India.**

## 5. The Realms of Water

- (i) Submarine relief and deposits of the Atlantic, Pacific and Indian Oceans.

*The depth and the features. The sea floor deposits and their characteristics, the importance of marine resources. Ocean pollution and ways to overcome them.*

- (ii) Ocean water - salinity, temperature, density.

*Composition of seawater and factors that control distribution of salinity, density and temperature.*

- (iii) Ocean water movements.

*Direct and indirect tides – origin, time, spring and neap tides. Waves – parts, characteristics, formation. Currents - factors affecting currents, currents of Indian, Pacific and Atlantic oceans. Role of currents in modifying climates of coastal areas. Introduction to El Nino and El Nina as conditions that affect the intensity of the monsoons over India.*

## 6. Biosphere – Life on the Earth

- (i) Nature of Biosphere, concept of ecosystems, components of ecosystem.

*Meaning, nature of interaction between the different components of the biosphere. Understanding the concept of biodiversity. To appreciate various reasons for valuing and conserving biodiversity (ethical, moral, economic, aesthetic).*

- (ii) Biodiversity for sustenance of mankind.

*The various roles played by biodiversity in sustaining mankind - as a source of food, medicine, pollution control, etc.*

- (iii) India as a mega diversity nation.

*A basic understanding that India with its varied climate and landscape is home to a variety of unique ecosystems and endemic species e.g. the largest mangrove forest in the world - the Sundarbans, vast mountain forests in the Himalayas, tropical evergreen forests in the Western Ghats and the North-*

*East region, desert vegetation in Rajasthan, thorn and scrub forests in the plateaus, etc.*

- (iv) Loss of biodiversity - threatened, endangered and extinct species.

*Understanding the implications of loss of biodiversity.*

*Categorizing species in different groups like - threatened, endangered and extinct. Examples of plants and animals.*

- (v) Strategies for conservation of biodiversity – in-situ and ex-situ.

*Looking at various in-situ and ex-situ strategies for their efficacy and viability:*

*In-situ strategies - protected areas (biosphere reserves, national parks, wildlife sanctuaries).*

*Ex-situ strategies - captive breeding, zoo, botanical garden, gene banks and their use.*

## 7. A. World Climatic types

### Low latitude / tropical climates

(i) Equatorial (ii) Monsoon and trade wind littoral (iii) Dry tropical (desert).

### Mid latitude/temperate climates -

(i) Mediterranean (ii) Marine west coast (iii) Dry sub-tropical (iv) Dry mid latitude (cold deserts).

### High latitude/polar climates -

(i) Boreal (ii) Tundra

*For each of the above climatic types, the following is to be studied:*

- Location, climatic conditions and areas;
- Description of major human activities (both farming and forestry.)

## B. Climate Change – causes/factors of climatic changes in the recent past.

*Natural and man-made factors, with special reference to climatic changes in India. Measures taken to adapt to these changes in urban and rural India.*

## MAN- ENVIRONMENT INTERACTION

### 8. Natural hazards, their causes and management

- (i) Hazards of volcanic eruptions and earthquakes.

*Major volcanic areas and their problems; major earthquake prone areas - effects on land and human life. Seismic zones of India and measures to reduce the fury of earthquakes.*

- (ii) Identification of major drought prone areas.

*Characteristics of drought prone areas. Causes, problems and remedial measures (like rain water harvesting) adopted with special reference to India.*

- (iii) Areas prone to floods / landslides - India.

*Landslides - causes, effects and measures adopted to check (Himalayan region). The causes of flooding and checking floods (like construction of dams and afforestation) – with special reference to India.*

### 9. Map Work

A question on map work will be set to identify, label and locate any of the following items studied in topics from **Principles of Physical Geography** and cities from Climatic Regions only.

#### MAP LIST

**Mountains:** Himalayas, Hindukush, Elburz, Zagros, Kirthar, Caucasus, Alps, Pyrenees, Carpathians, Urals, Khingan, Kunlun, Altai, Drakensburg, Kjolen, Andes, Rockies, Appalachian, Great Australian Alps, Verkhojansk, Great Dividing Range, Southern Alps.

**Plateaus:** Tibetan, West Australian, Iranian, Anatolian, Pamirs, Ethiopian, Bolivian, Deccan, Guiana, Colorado, Brazilian, Labrador, Arabian.

**Water Bodies (bays, gulfs, straits, sea, oceans):** Arctic Ocean, Atlantic Ocean, Indian Ocean, Pacific Ocean, Southern Ocean, Beaufort Sea, Hudson bay, Gulf of California, Gulf of Mexico, Panama Canal, Bering Sea, Sea of Okhotsk, Sea of Japan, East China Sea, South China Sea, Yellow Sea, Timor Sea, Tasman Sea, Persian Gulf, Red Sea, Black Sea, Mediterranean Sea, Caspian Sea, Arabian sea, North Sea, Baltic Sea, Suez Canal, Strait of Magellan, Bay of Biscay, Bay of Bengal, Andaman Sea, Lakshwadweep Sea.

**Rivers:** Mississippi, Missouri, Mackenzie, Amazon, Orinoco, St. Francisco, Parana, Orange, Nile, Zaire, Niger, Zambezi, Rhine, Rhone, Seine, Danube, Volga, Euphrates, Tigris, Thames, Ob, Yenisei, Lena, Amur, Hwang Ho, Yangtze Kiang, Sikiang, Mekong, Irrawaddy, Salween, Indus, Ganga, Godavari, Murray, Darling.

**Ocean Currents:** North Pacific current, Alaska current, North Atlantic Drift, Gulf Stream, Labrador current, North Equatorial current, South Equatorial current, Equatorial Counter current, Peru current, South Pacific current, South Atlantic, Current, West wind drift, South Indian current, Benguela Current, Brazilian current, Southwest Monsoon current, Indian counter current, Mozambique current, West Australian current, KuroShio current, Oyashio current, East Australian current, Guinea current, Falkland current.

**Islands:** Greenland, Hawaii, Aleutian, West Indies, Tierra del Fuego, Galapagos, Baffin, Newfoundland, Iceland, British Isles, Canaries, Corsica, Sardinia, Sicily, Madagascar, Sri Lanka, Philippines, Papua New Guinea, Indonesia, Japan, Australia, New Zealand, Tasmania.

**Climatic Regions:** Equatorial, Monsoon, trade wind littoral, Dry tropical (desert), Mediterranean, Marine west coast, Dry sub-tropical, Dry midlatitude (cold deserts), Boreal, Tundra.

## PAPER II: PRACTICAL WORK AND PROJECT WORK (30 Marks)

Candidates will be required to undertake the following Practical work and Project work:

### 1. Practical Work

Any **three** of the following four topics to be undertaken.

- (a) Surveying - elementary principles; preparing plans of the school compound or a small area with the help of chain and tape.
- (b) Statistical diagrams - line graphs (simple and multiple), composite bars, pie diagram, flow and star diagram, (the data used will be that used in Paper I).
- (c) Map projections – uses, construction and properties of the following:
  - (i) Cylindrical equal area.
  - (ii) Simple conical with one standard parallel.
  - (iii) Zenithal equidistant.
- (d) Aerial photographs – Introduction; definition; difference between map and an aerial photographs; uses of aerial photographs, advantages of aerial photography.

*Types of Aerial Photographs:*

- (i) *Based on the position of the cameral axis – vertical photographs, low oblique, high oblique (only definition and explanation).*
- (ii) *Based on Scale – (a) Large scale photographs (b) Small scale photographs. Scale of Aerial Photograph – (a) by establishing of relationship between photo distance and ground distance; (b) by establishing relationship between photo distance and map distance.*

### 2. Project Work (Assignment)

Fieldwork to understand any physical phenomena in the local or selected area to illustrate the physical processes (**One** topic as an assignment. Sketches and drawings will be given credit).

- (i) Take any physical feature in your immediate locality:
  - (a) draw sketches or take photographs to highlight physical features.
  - (b) survey how these features have been used and prepare a report.
  - (c) suggest ways by which the area of study could be better used keeping in view the needs of the people of the region.
- (ii) Choose any island area of the world or India and:
  - (a) trace the map of the area and show physical features, towns and port cities.
  - (b) prepare a project report using photographs and pictures from brochures and magazines to show:
    - its origin and formation.
    - soil types, vegetation.
    - human occupations.
- (iii) Any natural hazard like drought, flood, erosion, landslides, etc. in a local area.

*Choose a natural hazard in the local area. Describe the nature of damage by consulting newspaper reports, studies, interviews with local people. Identify the nature of damage before and after – land, building, public property, soil, vegetation, animals, etc. What are the chances of it occurring again and what precautions are being taken?*

## CLASS XII

There will be **two** papers in the subject:

**Paper I** – Theory (3 hours) ...70 marks

**Paper II** – Practical and Project Work ...30 marks

### PAPER I: THEORY (70 Marks)

There will be one Theory paper of **three** hours duration divided into **two** parts:

**Part I (30 marks)** will be **compulsory** and will consist of Section A and Section B.

**Section A** will include **compulsory** short answer questions testing knowledge, application and skills related to elementary/fundamental aspects of the entire syllabus.

**Section B** will consist of one question on **map work**.

**Part II (40 marks)** will consist of **seven** questions. Candidates will be required to answer **four** out of seven questions. Each question in this part shall carry **10 marks**.

### INDIA IN THE WORLD'S CONTEXT

#### 1. Physical Environment

- (i) **Locational setting - India:** size and area. Present importance of the location of India with reference to the Indian Ocean Rim countries and the Northern and Western frontiers. Comparison with China and Australia.

*Extent, position with reference to latitude and longitude, length of coastline and frontiers with neighbouring countries. The locational advantages of India in the Indian Ocean and as a subcontinent.*

- (ii) **Structure of India** – Geological formation, relief and drainage; major physiographic divisions and their characteristics.

(a) *Outline of the geological evolution and structure: basic definitions – geology, era, periods, physiography, geological structure, stratigraphy.*

*Names of the main Standard and Indian geological eras with reference to Indian Geology.*

*Geological evolution of: the Peninsular Plateau, the Himalayas and the Great Plains. Difference between the Peninsular Plateau and the Himalayas. (The Geological rock formations of India are **not required**).*

- (b) *The three-fold physiographic divisions: the Himalayan mountain complex, the Indus-Ganga-Brahmaputra Plains and the Peninsular Plateau.*

- **Himalayan mountain complex: (orthoclinal structure)**

*The three parallel ranges, the northwest and northeast offshoots, comparison between Western and Eastern Himalayas.*

*Regional divisions of the Himalayas (Kashmir/ Punjab Himalayas, Himachal/ Uttranchal/ Kumaon Himalayas, Nepal Himalayas, Assam Himalayas).*

- **Indus-Ganga-Brahmaputra Plains**

*The relief features – bhabar, tarai, bhangar, khaddar, bhur, barind, barkhans, doabs. Regional divisions of the plains: Rajasthan plain (the Great Indian desert), Punjab plain, Ganga plain, Brahamaputra/ Assam plain.).*

- **The Peninsular Plateau**

*The Malwa plateau, Chotanagpur Plateau and Deccan Plateau: the relief features - badland, Western Ghats, Eastern Ghats, Aravalis. Comparison between the Western Ghats and the Eastern Ghats.*

**The above three physical divisions are to be studied with reference to their extent, altitude, slope and landform characteristics.**

- **Coastal Plains**

*Comparison between Western and Eastern Coastal Plains and their divisions. The relief features: Lagoons, estuaries, deltas.*

- **Islands**

*Difference between Andaman and Nicobar and Lakshwadweep islands.*

- (c) **Drainage (i.e. rivers) and drainage systems:** Names and sources of the main rivers and their major tributaries (Extent of river basin area **not required**).

*Comparison of Himalayan and Peninsular rivers.*

(iii) **Climate: India** - Factors affecting India's climate: Temperature - factors affecting temperature. Atmospheric pressure conditions during the year; origin and mechanism of the monsoon, Jet streams, Southern Oscillations; wind and rainfall distribution during the year; characteristics of the four main seasons - hot and dry, hot and wet, cool and dry, cool and wet with reference to temperature distribution in north and south India, pressure, wind conditions - distribution of resultant rainfall; variability of rainfall, incidence of droughts and floods. Temperature and rainfall graphs of Mumbai, Delhi, Kolkata, Chennai, Jaisalmer, Leh, and Hyderabad.

*Role of various factors affecting Indian climate - latitudinal extent, distance from the sea, northern mountain ranges, physiography, monsoon winds, upper air circulation, western disturbances and tropical cyclones, southern oscillation, El Nino; understanding of the concept and mechanism of monsoon; Indian Monsoonal Regime - onset, rain bearing system, break in the monsoon, retreat of the monsoon;*

*Seasons of India - with reference to temperature, pressure distribution, wind systems and local winds (loo, kalbaisaki/Norwesters, Mango showers; explanation of the variability of rainfall in different areas over different seasons.*

*Droughts and Floods - meaning, causes, affected areas and mitigation programmes. Temperature and rainfall graphs of Mumbai, Delhi, Kolkata, Chennai, Leh, Jaisalmer and Hyderabad.*

(iv) **Natural vegetation:** Major vegetation types of India, their geographical distribution with reference to rainfall and temperature conditions - description of the important tree types and their adaptation to the climate. Forest - area covered, importance, use, misuse and potential both for exploitation and conservation. Present forest policy.

*Distinction between vegetation and forest, virgin vegetation; factors affecting vegetation.*

*Classification of vegetation types - tropical evergreen, monsoon forests, tropical dry forests, arid forests, deltaic forests, mountain forests and their geographical distribution and adaptation.*

*Importance of forest to man; Impact of human activity on vegetation. Forest area and forest cover in India. Forest Conservation - need, Social Forestry (Agro forestry, community forestry, commercial farm forestry, non-commercial farm forestry, urban forestry); Forest Conservation Movement: Van Mahotsav, Chipko Movement.*

*National Forest Policy (1988): objectives of the Forest Policy; Integrated Forest Protection Scheme.*

## 2. Population and Human settlements

(i) Population of India compared to six countries - China, Australia, USA, Canada, Russia and Brazil.

*Population of India as compared to the other six countries with reference to percentage of world population and India's position in the world.*

(ii) National and State level patterns of population distribution.

*Definition of census. Index of concentration (highest and lowest index of concentration as per the latest census), density of population - arithmetic and physiological.*

*Spatial distribution of population in India and explanation of the factors influencing it - landforms, climate, accessibility and level of development that result in this pattern. Comparison of the density at the State level and factors influencing it.*

(iii) Pattern of population growth in the last three decades; implications for development.

*Meaning of terminologies such as population, birth rate, death rate, population growth rate, natural growth rate and absolute growth of population, migratory growth, positive and negative growth.*

*Population growth of India at national level - trends of 1921, 1951 and 1981 to the latest Census, absolute growth rate of population. Demographic characteristics of India at the*

*National level- birth rate, death rate, and natural growth rate from 1991 to the latest Census.*

Drawing general conclusions about the:

*Impact of rapid growth rate on economic development, on environment; need for planned development (to maintain the ecological balance).*

- (iv) Migration trends over the last 25 years.

*Explanation of the important terms – migration, commutation, out migration, in migration, step-wise migration and migrant, push and pull factors.*

*Types (National and International migration, inter migration and intra migration, urban migration and rural migration) and trends of migration.*

*Streams of migration: (rural-rural, rural-urban, urban-urban and urban-rural).*

*Causes for migration - natural, economic, political and social.*

*Comparing the consequences of each type of migration on cities and rural areas.*

- (v) Demographic attributes at National level - trends and patterns of: 1. Rural urban population 2. Age and sex composition 3. Literacy levels 4. Working and non-working population; implications for development.

*Study of the causes and trends of rural urban composition, age and sex ratio, literacy level, working and non-working population at the National level (highest and lowest figures for each of the above) in the latest census. Implications for development.*

- (vi) Rural settlements – size and number of villages as per the latest census. Types and patterns in hill areas, plains and coastal locations.

*Distinction between Rural and Urban settlements; Rural and Urban Population. Classification of villages as per the latest census.*

*Factors affecting the types (distinction between compact and dispersed) and*

*patterns (linear, circular, star shaped, rectangular, shapeless) of rural settlements in plains, coastal areas, mountains and plateau areas.*

- (vii) Urban settlements – size classification of towns as per the latest census. Study of population growth in Delhi, Mumbai, Kolkata and Chennai from 1951 till the latest census.

*Definition of an Urban area according to the latest census; Urban agglomeration, conurbation, urban sprawl, ribbon settlement, infill, metropolis, megalopolis.*

*Trends of urbanization **only** in Delhi, Mumbai, Kolkata and Chennai from 1951 till the latest census.*

*Factors that influence the growth of urban centres in India. Problems and advantages of urban growth.*

### **3. Resources of India and their Utilisation**

- (i) Need for environmental management vis-à-vis development.

*Understanding that from the development point of view, environment may mistakenly be seen as a 'resource' to be exploited, whereas, environment needs to be viewed as a 'capital' that needs to be managed carefully.*

- (ii) Land resources: Land use pattern in India – quality of cultivable land, size of land holdings.

*Defining the term land resource; its importance and problems. Land use pattern – net sown area, area sown more than once, forests, land not available for cultivation, permanent pastures and other grazing lands, land under miscellaneous tree crops, culturable (cultivable) waste, fallow land, quality and size of cultivable land holdings. Methods to reduce fragmentation of land holdings.*

- (iii) Water resources and types of irrigation.

*Water Resources: Their demand and utilization. Types of water resources: surface and ground water.*

*Meaning, importance and need for irrigation in India.*

*Sources of irrigation:*

*Traditional Methods: wells, tanks, tube wells - Advantages and disadvantages; Study of two states where each of the above types of irrigation is mainly prevalent.*

*Modern methods: tube wells, multi-purpose projects, sprinkler irrigation, Perennial canals - Advantages and disadvantages. Names of two canals each in Uttar Pradesh, Punjab, Haryana, Andhra Pradesh, Tamil Nadu and Maharashtra.*

*Use and misuse of water for irrigation; study of alternative methods of irrigation. Overwatering - reasons and regions affected by it; dangers of overwatering;*

*Conservation of water resources including their management; rain water harvesting.*

(iv) Agriculture: Types, development and problems.

(a) Wet and dry farming, crop rotation and crop combination, intensity of cropping, problems of Indian agriculture; use of technology in agriculture. Modern inputs, change over from subsistence to commercial agriculture, need for Green Revolution. Diversifying Indian agriculture – importance of animal husbandry.

*Wet and dry agriculture: Crop rotation and crop combination. Intensity of cropping – concept and crops associated; problems of Indian agriculture; Use of new technology – Green revolution: Need, impact and problems, second green revolution - strategies for second green revolution. Diversification of Indian agriculture – Animal Husbandry: meaning and its importance in Indian Agriculture.*

(b) Study of crops:

(i) Conditions of growth (soil, temperature, rainfall requirements, crop seasons, secondary crops cultivated with them). (ii) World production and India's position. (iii) Major producing States in India and their rank as producers of the following crops:

**Food grains** - Rice (Japan), Wheat (China), Coarse grains – Sorghum (Jowar, Maize), Pennisetum (Bajra or Camboo), Eleusine (Ragi), Pulses.

**Commercial and Industrial crops** – Coffee (Nilgiris and N.E. India), Tea (Sri Lanka), Cotton (Pakistan), Sugarcane (China), Jute (Bangladesh), oilseed cultivation in India particularly of Groundnut, Coconut (Sri Lanka).

*Conditions of growth: For each crop, the type of soil, temperature range, rainfall range, the crop seasons are to be done.*

*Main areas of growth of the above crops, in the countries specified, and reasons for growth are to be studied.*

*Name of the leading producer (country) in the world for each of the above crops (Food grains, commercial and industrial crops) and India's position in the world.*

**NOTE: Comparative study between countries with regard to food grains, commercial and industrial crops is not required.**

**Importance of Market Gardening and Orchard Farming** – reasons and trends in development in recent years.

*Self-explanatory*

(v) Fishing in India, Japan and Bangladesh.

*Methods, types of fish caught, fishing grounds; factors affecting the importance and development, fishing ports and markets, need and methods of fish conservation.*

*Understanding of marine and inland fisheries; deep sea and inshore fishing; pelagic and demersal fishing should be done. Problems affecting fishing in India, Japan and Bangladesh should be also taken up.*

*Two ports and two types of fishes of each coastal State in India should be studied.*

(vi) Sources of Energy

(a) Minerals and power resources.

*Distinguishing between metallic and non-metallic minerals; ferrous and non-ferrous minerals.*



*Production and distribution (three leading States and three leading centres in each State) of Iron ore, mica, coal, manganese and petroleum; their uses.*

*Iron ore, mica, coal: their types.*

*The main power resources - Nuclear thermal, hydel; three main States for generation of nuclear thermal and hydel power in India.*

- (b) Conventional energy sources - fossil fuels and firewood, potential (Indian context) and limitations of each source, methods of harnessing and environmental consequences of their use.

*Conventional energy sources:*

*Firewood – for heating and cooking along with agricultural and animal waste.*

*Coal, Petroleum, diesel, LPG - their potential and limitations in India. Environmental concerns with regard to their use (global warming, thermal pollution in waters, fly ash, atmospheric pollution, etc.).*

- (c) Non-conventional energy sources - types of non-conventional sources (bio-mass, solar, wind, ocean, hydel, geothermal, nuclear), potential (Indian context) and limitations of each source; their environmental consequences; need to promote non-conventional energy sources.

*Advantages and limitations of each non-conventional energy source.*

*Uses of these energy sources and distribution.*

*Understanding the need to promote non-conventional energy sources.*

*(The study should include uses and the distribution of the above energy resources).*

#### **4. Infrastructural Resources** (Development of Transport and Communication).

- (a) Railways, Roadways, Water transport (inland and coastal), Air transport, Pipelines - these modes of transport are to be studied with regard to –

Location and state wise distribution of air, road and rail routes; location of waterways and pipelines; natural and economic factors that govern their distribution; density and growth. Patterns in India.

*The present position, areas well and poorly served by each mode.*

*Problems – comparative advantage of each mode of transport, national goals to be achieved in the development of modes of transport (The Golden quadrilateral - its north-south and east-west corridor).*

Ports, their location and advantage; major exports and imports of different ports. Nature and direction of trade from the ports. International trading patterns and products in the last five years.

*Distinguishing between harbour and port; natural and artificial harbours. Location of major ports in India and their advantage; main items of export and import from different ports and the patterns in the last five years.*

- (b) Communication – importance of communication in rural development and its policy. Importance of infrastructure as key to the development of an industrial economy.

*Modern means of communication - satellites and remote sensing - Geographic Information Systems (GIS), cellular phones, radio, doordarshan, internet; difference between mass communication and tele communication. Prasar Bharti. Infrastructure as key to the development of an industrial economy.*

## 5. Industries

- (a) Study of the location and distribution of important industrial centres; a general comparison of disparities.

*Self-explanatory.*

- (b) Major and minor industrial regions – factors governing their growth.

*Reasons for the spread of industrial areas; Understand how the distribution of heavy and consumer industries varies in the different regions; Understanding why certain industries are more in a particular region.*

*Major Industrial regions: Mumbai-Pune, Hooghly, Bengaluru-Tamil Nadu, Gujarat, Chota Nagpur, Vishakhapatnam-Guntur, Gurgaon-Delhi-Meerut.*

*Minor Industrial regions: Ambala-Amritsar, Saharanpur-Muzaffarnagar, Northern Malabar.*

*Factors governing the growth of the above to be studied.*

- (c) Location, production and growth of the following industries:

- (i) **Agro based industries** – Sugar, cotton textile and ready-made garments.

*Sugar Industry:*

*Maharashtra (Ahmednagar and Pune), Uttar Pradesh (Muzaffarnagar and Saharanpur), Tamil Nadu (Coimbatore and North Arcot).*

*Cotton Textiles:*

*Maharashtra (Mumbai and Pune), Gujarat (Ahmedabad and Surat), West Bengal (Kolkata and Howrah), Tamil Nadu (Madurai and Chennai).*

*Ready-made garments:*

*Delhi, Bengaluru, Mumbai, Kolkata*

- (ii) **Mineral based industries** – Iron and steel, aluminium, cement, and transport equipment. Petrochemicals, including refineries and fertilizers.

*The following industrial centres of each industry are to be studied.*

*Iron and Steel:*

*TISCO (Jamshedpur), Vishweshwarya Iron and Steel Plant (Bhadravati), Bhilai Iron and Steel Plant (Bhilai), Rourkela Iron and Steel Plant (Rourkela), Hindustan Steel Limited Plant (Durgapur), Bokaro Iron and Steel Plant (Bokaro), Salem Iron and Steel Plant (Salem), Vishakhapatnam Iron and Steel Plant (Vishakhapatnam), POSCO(Paradwip).*

*(Integrated and mini steel plants: meaning, advantages and disadvantages also to be studied.)*

*Aluminium:*

*INDAL (Hirakud), HINDALCO (Renukoot).*

*Cement:*

*Katni Cement and Industrial Company Limited (Katni), Andhra Pradesh (Krishna, Vijaywada), Rajasthan (Savai Madhavpur, Udaipur).*

*Transport equipment:*

*Chittaranjan Locomotive Works (Chittaranjan), Diesel Locomotive Works (Varanasi), TELCO (Jamshedpur), BHEL (Bhopal).*

*Automobile Industry:*

*Maruti Udyog (Gurgaon), Premier Automobiles (Mumbai).*

*Ship Building Industry:*

*Hindustan Shipyard Limited (Vishakhapatnam), Cochin Shipyard Limited (Kochi), Mazgon Dock (Mumbai) Garden Reach Workshop(Kolkata).*

*Aircraft Industry:*

*HAL-Hindustan Aeronautics limited (Nasik, Koraput, Bengaluru).*

*Petro Chemicals:*

*UDEX (Koyali), IPCL (Vadodara).*

*Oil refineries:*

*IOCL (Barauni, Haldia and Digboi), HPCL (Mumbai and Vishakhapatnam).*

*Fertilizers:*

*FCI (Sindri), HFCL (Barauni), IFFCO (Kandla).*

**NOTE: Factors responsible for the location, development and present status of the Agro and Mineral based industries mentioned above, as well as the distribution centres are to be studied.**

*Difference between key and footloose industry; industrial clusters and indices to identify industrial clusters; industrial inertia.*

*Maps and sketches of Industrial regions and centres (location of agro based and mineral based industries) should be the basis for explaining the pattern of industrial development.*

- (d) Tourism industry – Major natural and cultural tourist areas in India. Their special features and level of development - impact on environment and local economy. Tourist flows.

*Definition of tourism, growth of tourism, advantages of tourism, important places – both natural and cultural. Positive and negative impact of tourism, problems of tourism and measures for developing eco-tourism.*

## **6. Regional Economic Development**

(Case studies)

Case studies will be preceded by a brief understanding of the meaning of development, multilevel planning and planning regions. These case studies will be undertaken with reference to the advantages and disadvantages that have accrued to the people and area - aspects covered will be their geographical location, resource base, developmental history, present trends of population, occupations, agriculture and industrial activities, issues of development.

1. Area development in Chattisgarh region – mining, silk industry and farming.
2. Electronics industry in Bengaluru– reasons for its development, extent, national and international linkages and problems.
3. Growth of Haldia port, its industries and hinterland.

## **7. Map Work**

A question on map work will be set to identify, label and locate any of the following items studied in topics 1-6:

### **MAP LIST:**

#### Locational setting of India:

*8°4'N-37°6'N, 68°7'E- 97°25'E (Latitudinal and longitudinal extent of India); 23.5° N (Central latitude) and 82.5° E (Central longitude); Indira Col and Cape Comorin (Northern and Southern point of mainland India).*

#### Mountains:

*3 parallel ranges of Himalayas, Trans Himalayan range – Karakoram, Pir Panjal, Ladakh, Zaskar. Aravallis, Vindhya, Satpura, Western and Eastern Ghats, Nilgiris, Cardamom hills, Garo, Khasi, Jaintia hills, Patkoi hills, Naga hills, Mizo hills.*

#### Peaks:

*Mount Everest, Godwin Austin, Kanchenjunga, Gurushikhar, Dodabetta, Anaimudi, Mahendragiri,*

#### Plains:

*Indus-Ganga-Brahmaputra region, Konkan, Kanara, Malabar, Coromandel, Northern Circars.*

#### Plateaus:

*Malwa, Chota Nagpur, Deccan, Meghalaya.*

#### Peninsula:

*Kathiawar, Kachchh.*

#### Lakes:

*Chilika, Pulicat.*

#### Waterbodies:

*Arabian Sea, Bay of Bengal, Palk Strait, Gulf of Kachchh, Gulf of Khambat,*

#### Passes:

*Karakoram, Shipki La, Nathu La, Bomdi La, Palghat, Bhorghat, Thalghat.*

#### Rivers:

*Indus, Jhelum, Chenab, Ravi, Beas, Sutlej, Ganga, Yamuna, Gomti, Ghaghara, Gandak, Kosi, Chambal, Betwa, Ken, Son, Damodar, Luni, Narmada, Tapi, Mahanadi, Godavari, Krishna, Kaveri, Brahmaputra.*

#### Climate of India:

*Movement of Southwest and North east monsoon winds from season to season, area of low and high pressure varying from season to season, direction of*

westerly and easterly jet streams, average annual rainfall distribution in India, Main drought prone and flood prone areas.

Natural Vegetation:

Main area of: Tropical Evergreen, Tropical Deciduous, Tropical dry, Deltaic and Arid forests.

Population:

The States of India (according to the latest Census) for the following: The Lowest density of population, highest density of population, highest level of urbanization, lowest level of urbanisation, highest Index of Concentration of population, the highest sex ratio, the lowest sex ratio, the highest literacy, the lowest literacy;

Urban cities of Delhi, Mumbai, Chennai and Kolkata, Bengaluru, Hyderabad, Ahmedabad, Jaipur, Lucknow, Patna, (metropolitan and capital cities).

Resources of India:

Main region of intense cropping in India; Main State/regions of India for: wells, tanks, tube wells, perennial canals.

Agriculture:

Main producing States/regions of India for: Rice, Wheat, Maize, Jowar, Bajra, Ragi, Pulses, Coffee, Tea, Cotton, Jute, Sugarcane, Groundnut, Coconut.

Minerals:

Iron Ore (Keonjhar, Bellary, Raigarh, Singhbhum), Coal (Jharia, Bokaro, Raniganj), Petroleum (Digboi, Mumbai High, Ankleshwar, Bassein), Manganese (Sundergarh, Nagpur) Mica (Nellore, Bhilwara).

Power resources:

Nuclear Power (Kaiga, Kalpakkam, Tarapur, Rawatbhata, Narora, Kakrapara), Thermal Power (Bongaigaon, Santaldih, Panipat, Ahmedabad, Chandrapur, Neyyelli, Trombay, Vijaywada); Hydroelectric power stations (Bhakra Nangal, Hirakud, Damodar, Nagarjunasagar, Tungabhadra, Rihand).

Industries:

Sugar Industry: Ahmednagar, Pune and Coimbatore; Cotton Textiles: Mumbai, Ahmedabad Surat and Madurai.

Iron and Steel: TISCO(Jamshedpur), Bhilai Iron and Steel Plant (Bhilai), Vishakhapatnam Iron and Steel Plant (Vishakhapatnam);

Aluminium: INDAL (Hirakud), HINDALCO (Renukoot);

Cement: (Katni) and (Udaipur);

Transport equipment: Chittaranjan Locomotive Works (Kolkata) and DLW (Diesel Locomotive Works - Varanasi).

Automobile Industry: Maruti Udyog (Gurgaon), Premier Automobiles (Mumbai).

Ship Building Industry: Hindustan Shipyard Limited (Vishakhapatnam), Cochin Shipyard Limited (Kochi), Mazgon Dock (Mumbai); Garden Reach Workshop (Kolkata).

Aircraft Industry: HAL - Hindustan Aeronautics Limited (Nasik, Bengaluru, Kanpur);

Petro Chemicals: UDEX (Koyali) and IPCL (Vadodara);

Oil refineries: IOCL (Digboi, Barauni and Haldia);

Fertilizers: FCI (Sindri), IFFCO (Kandla).

Transport:

Trace the route of: National Highway 1, National Highway 2, National Highway 6, National highway 7, Golden Quadrilateral - 4 sides, North south Corridor, East West Corridor; State with the Highest Density of roads.

Ports:

Kandla, Mumbai, Marmagao, New Mangalore, Kochi, Tuticorin, Haldia, Chennai, Vishakhapatnam, Kolkata.

Hinterland:

Kolkata, Haldia.

Case studies:

Tracing of the Chattisgarh region, city of Bengaluru and its connectivity (road and rail ways) with the adjacent megacities & ports and hinterland of Haldia.

**SKETCH MAPS**

Candidates should be able to draw, label, understand and interpret the sketch maps related to the following topics:

- Locational setting of India;
- Relief and drainage of India;
- Climate;
- Population;
- Industries.

## PAPER II: PRACTICAL WORK AND PROJECT WORK (30 Marks)

Candidates will be required to undertake the following Practical work and Project work .

### 1. Practical Work:

Any **four** of the following topics to be undertaken:

- (i) Drawing of scales: linear, graphic scales showing primary and secondary divisions; representative fractions and statement of scale methods.
- (ii) Drawing of cross-section or profiles of important contours, viz. ridge, plateau, escarpment, valley, conical hill, types of slope, sea cliffs, waterfalls, spurs, by using vertical exaggeration and horizontal equivalent.
- (iii) Understanding and illustrating location references of SOI maps.
- (iv) Map reading and interpretation of survey of India maps: Study will be based on representative portions of any **two** topographical sheets. It will include the description of location, extent, relief features, drainage, land use, settlement patterns, communications and inferences about human occupations and stage of economic development of the area.
- (v) Introduction to Geographic Information System: Elements of visual interpretation of remote sensing maps/ images.  
Colour significance in the image and true colour (false colour composition): texture; size; shape; shadow; association.  
(Reference material – Wikipedia, Google. earth, IIRS Hyderabad).
- (vi) Elementary principles of surveying an area: preparing two plans of school compound and/or a small area using Plane table/ GPS.

### 2. Project Work (Assignment):

Local field surveys on any **one** of the following will be submitted as Project Report. These surveys should be organized with a table of contents, sample taken and statistical methods used, interview schedule. The report should be organized systematically, and the conclusions should be clearly stated.

- (i) Agricultural land use survey.

*Choose a district or topographical map of an area 1: 250000 and make a sketch map showing land use; compare the patterns of these. Alternatively, a local village could be chosen and the fields mapped from the cadastral map with information on the crops grown in different seasons and the location of the village, its roads and landmarks, if any.*

- (ii) Household survey of about 30-60 households of a village or locality.

*Family size, age structure, educational background, occupation, involvement of men and women in economic activity, educational service. Draw conclusions to reflect the economic development of the households.*

- (iii) Amenity study.

*Study of hospitals in a city, schools (school where you studied), post offices, municipal zones within the city (blocks in a village study) – reasons for travel (based on the importance and demand for the place), travel time, travel distance, mapping the hinterland of the service.*

- (iv) Study of a manufacturing industry or a self-employed person.

*Visit a manufacturing unit or self-employed person – cycle or car repair shop, small fabricating unit, factory if nearby and find out – source of raw material, supply routes, final product, areas where it is sent, manpower strength and their organization.*

- (v) Area development of a multipurpose river valley project – impact on the region.

*Self-explanatory.*

The Practical Work and the Project Work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council. No question paper for practical work and project work will be set by the Council.

Evaluation of Practical Work and Project Work will be as follows:

<b>Practical file (Sessional Record):</b>	10 marks
<b>Assignment (Project Report):</b>	10 marks
<b>Viva voce:</b>	10 marks

# SOCIOLOGY (854)

## Aims:

1. To familiarise candidates with the basic concepts of Sociology and Anthropology.
2. To develop in candidates an understanding of various forces that constitutes social life and social problems.
3. To create an awareness of the process of change and development in general and with reference to the Indian society in particular.
4. To provide candidates with the means whereby they can come to a better understanding of other cultures as well as of their own.
5. To form in candidates, the habit of scrutinising social assumptions and beliefs in the light of scientific evidence.
6. To introduce a deeper study of the subject for the tertiary level.

## CLASS XI

There will be **two** papers in the subject:

**Paper I** - Theory: 3 hours .....70 marks

**Paper II**- Practical Work .....30 marks

### PAPER - I (THEORY) – 70 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (50 marks)** will consist of **eight** questions out of which the candidate will be required to answer **five** questions, each carrying **10 marks**.

#### 1. Origin and Development of Sociology and Anthropology

- (i) Emergence of Sociology and Anthropology as Disciplines.

*Discuss the definition, origin and growth of the two disciplines briefly.*

*Define the nature and scope of Sociology.*

- (ii) Classical Thinkers and Theories.

Contribution of the Classical Thinkers on the basis of their theories.

*Discuss the contribution of the following on the basis of the given theories:*

- *Auguste Comte – Positivism;*
- *Herbert Spencer – Theory of Evolution (use Social Darwinism, Organic Analogy);*

- *Emile Durkheim - Structural Functionalism (use the concepts sacred and profane, division of labour, solidarity)*
- *Max Weber - Interpretive Sociology (bureaucracy, types of authority);*
- *Karl Marx - Conflict Theory (class and class struggle).*

- (iii) Sociology and other Social Sciences.

An understanding of the interrelationship between Sociology and other Social Sciences  
*Relationship between Sociology and other Social Sciences (similarities and differences) - Political Science, Economics, Anthropology (Physical Anthropology; Socio-cultural Anthropology), History, Psychology, Philosophy.*

#### 2. Research Methodology

Importance of research methodology in Sociology and Anthropology.

*Definition and importance of social research.*

*Methods of Sociology and Anthropology – Comparative method, statistical method, field work and case study method, historical method and scientific method (formulation of the problem, observation, classification, hypothesis, verification, and prediction).*

*Tools of data collection (primary and secondary): A brief idea of research tools used – questionnaire, interview, observation, documentary research. Definition, merits and demerits of the above.*

### 3. Basic Concepts

#### (i) Individual and Society.

Understanding the role of an individual and his relation to society.

*Definition of Society; characteristics of Society – to be explained in detail.*

*Discuss the definition, characteristics, problems and differences between Rural and Urban Society.*

#### (ii) Socialization – Man as a Social Animal.

Human being as a rational and social partner in environmental actions.

*Definition and characteristics of socialization; primary and secondary agencies of socialization (family, school, society, peer group, media, religion).*

*Definition of natural selection, social selection and heredity.*

*Nature vs. nurture – to be discussed briefly (Explain man as a social being, using the examples of the feral cases of Genie, Amla and Kamala and Anna. Documentaries on Genie and Anna may be shown as resource material).*

#### (iii) Culture

Notion and attributes of culture.

*Definition and characteristics of culture; brief explanation of the features of norms, folkways, mores, customs, values. Definitions only of material and non-material culture, culture lag and culture conflict.*

*A brief look at some past traditions and customs which reflect a close understanding of material and non-material culture e.g. sacred groves, johads, eris (water tanks of South India), farmers crops and growing season in complete harmony with the local environment and seasons, etc.*

### 4. Social Structure

#### (i) Social groups

*Definition and features of Community and Association, differences between Community and Association; definition and features of Primary Groups and Secondary Groups, differences between Primary Groups and Secondary Groups; definition and features of Organized and Unorganized groups (public, mobs, crowd and crowd behaviour),*

*differences between Organized and Unorganized groups; definition only of the Reference group, In-group, Out-group.*

#### (ii) Status and Role

*Definition of status; types of status - ascribed and achieved: definition, features and differences between the two; determinants of status.*

*Definition of role, role conflict and role stereotype.*

*The above to be explained with the help of examples with special reference to the Looking Glass Self Theory by C.H. Cooley (definition and brief explanation through one example).*

#### (iii) Social processes.

*Co-operation, competition and conflict – their definitions, characteristics and differences.*

### 5. Social Problems

Over population (with focus on poverty, unemployment, illiteracy), Child Labour, Juvenile Delinquency, Problems of the Aged and Problems of the Differently Abled (social and cultural attitude and built environment).

*All the above social problems to be discussed in detail highlighting their causes and remedial measures.*

*Additionally, problems of the aged and problems of the differently abled to be discussed with reference to social, cultural environment and the infrastructure - attitudes, special requirements e.g. ramps, signage.*

### 6. Indian Sociologists

Contribution of the Indian Thinkers in the field of Sociology: Radha Kamal Mukherjee, N.K. Bose, Irawati Karve, G.S. Ghurye, M.N. Srinivas.

*The following contributions of each of the thinkers are to be discussed:*

*Radha Kamal Mukherjee - Social Ecology;*

*G.S. Ghurye – Theories of Origin of the Caste system;*

*N.K. Bose – The Hindu Method of Tribal absorption;*

*Irawati Karve – Kinship and the family;*

*M.N. Srinivas – The Concept of Brahminization and Sankritization.*

## PAPER II (PROJECT WORK) – 30 MARKS

To do justice to the basic structural principles and theoretical orientation of the discipline, empirical and ethnographic substantiation is essential. In keeping with the significance of doing practical work and gaining a hands-on understanding of various social issues, candidates are expected to undertake **two studies**. Topics for the studies should be chosen from within the overall syllabus as there is ample scope for diversity.

Candidates will be expected to have completed **two studies** from any chapter covered in Theory. Assessment for each study will be as detailed below:

Mark allocation **per study** [15 marks] will be as follows:

Statement of the purpose	1 mark
Overall format	1 mark
Hypothesis	1 mark
Choice of technique	1 mark
Detailed procedure	4 marks
Limitation	1 mark
Conclusion	2 marks
Viva-voce based on the study	4 marks
<b>TOTAL</b>	<b>15 Marks</b>

### List of suggested studies for Project Work:

1. The problem of Child Labour in India.
2. Children and beggary.
3. Poverty and Crime.
4. The Population explosion and its impact on urban society.
5. The changing nature of culture and tradition.
6. Cultural fusion and Gen-X.
7. The Urban family, the role of Voluntary Associations or The Urban Neighbourhood.
8. Rural society in India or The Village in India (an example can be taken and elaborated upon), for e.g. Anna Hazare's village Ralegan Siddhi).
9. Biographical sketch of one of the thinkers – Weber, Comte, Srinivas, Ghurye, etc.
10. Slums in the urban neighbourhood.
11. Problems of the aged in India.
12. Problems of the differently abled in India

*The topics that have been outlined for Practical Work are based on the syllabus.*

*The project topics are diverse and at the same time there are common themes running through some of them. As this is so, it is possible to club some topics in terms of the methodology that can be used to carry out the research as has been done below.*

*The nature of the topics that have been chosen can also be separated into two categories. Some topics are theory based and so the methodology will largely be second hand information gathering from already available material, while there are also ethnographic topics for which students can go and do first hand field studies.*

*Some topics combine theory (second hand data) with the empirical (first hand data). It may be interesting if teachers guide students towards doing one study of each kind. This way a student will have some knowledge of both the theoretical as well as ethnographic character of social facts.*

*Guidelines for completing some of the studies for Practical Work are listed below. This may be used as a reference for conducting studies on other listed topics.*

- 1. The problem of Child Labour in India (S. No. 1 - List of suggested assignments for Practical Work)**
- 2. Children and Beggary (S. No. 2 - List of suggested assignments for Practical Work)**

The methodology and the analysis is the same for the above two topics.

**Aim:** To study the social position of children in India.

**Data:** The data available here is both secondary and empirical.

**Methodology:** Students should first identify the sample they are going to study. To do this, students must first seek out places where they can find children below the age of 15 years, engaged in doing work. These can be: their neighbourhoods, on way to school or near school, construction sites, roadside eateries, in homes, working in factories /repair shops, on street corner shops, children begging in the streets (or at religious places), at traffic lights, at railway stations, etc.



**Technique:** Students need to identify whom they are going to study and then gather their data

- by observing the daily routine of the child/children and recording this; and
- by creating a questionnaire to interview them for preparing a case history.

The student needs to ask questions about:

- the age (remember many will lie about their age as they know it is illegal to work)
- family background (members in the family /caste/class/ and religion)
- level of education and whether they would like to go to school
- whether they are migrants and why they have migrated
- the economic position of the family and why they work/and who all in the family work
- what they earn
- how they spend their free time
- what would they like to do if they did not have to work
- how aware are they about the government law against child labour.

Students can classify the data gathered also in terms of the differences between girls and boys as this will give an idea of gender discrimination existing in the sample.

The data gathered can be supported with a photo essay of the child /children studied and their living conditions/work place, etc.

**Interpretation:** An analysis of the data gathered is important and does not have to be complicated.

Students should be asked to do a critical examination of the data they gather by contrasting what they find from their study with the government laws, which can be found on the Internet.

Students should be asked to look for information on industries where child labour is used.

For example:

- The firecracker industry in Sivakasi,
- Aligarh lock industry,
- Firozabad bangle workers,
- Carpet makers in Benaras,
- Mine workers in Manipur,
- Football makers in UP.

**This information and the government legislations are easily available on the Internet.**

This will help them understand and analyse the problem they have chosen to study.

They should:

- (i) Examine why children are in these jobs/ positions;
- (ii) Examine failure of the family and so the need for children to work;
- (iii) Examine failure of the government to provide for such families;
- (iv) Examine how these children fail to be educated and whether boys are more educated than girls;
- (v) Examine the role of urban society in creating the need for such child labour (for example the employment of young girls to take care of children in many urban households);
- (vi) Identify how there is gender discrimination in terms of the kind of work boys and girls do;
- (vii) Examine if there is a pattern in the migration, i.e., whether they come from the same region, caste class and religion and how this can be related to the poor conditions of life where they are originally from.

### **Conclusion**

- Problems faced in data gathering and analyses to be mentioned.
- In conclusion, compare the situation of these children to their own urban advantaged upbringing and do a critique of the local government as well as a critical self-analysis.

### **3. The Population Explosion and its Impact on Urban Society (S. No. 4 - List of suggested assignments for Practical Work)**

**Aim:** To examine the relationship between urban expansion and the collapse of the urban society.

This collapse is reflected not only in a breakdown of law and order but also in the breakdown of urban infrastructure; and it leads to the growth of slums.

**Data:** Students can study a particular aspect of the collapse of the infrastructure.

For example:

- they can do a case study of the broken-down state of the roads,
- collapse of the transport system,
- the non-availability of water in their neighbourhoods,
- the power cuts,
- the rise of prices
- growth of the neighbourhood slum

**Technique:** Students will have to gather first hand material from around their neighbourhoods:

- by observing how things have collapsed or changed and record these
- by interviewing residents in the area chosen and ask them their opinion of the changes and what should be done to improve the situation
- by talking to local administrators like a councillor about why things have collapsed

Students can also take two neighbouring areas which seem different and compare the two areas.

**Interpretation:** The data gathered needs to be analysed by examining how:

- (i) Civic agencies have failed to provide basic amenities;
- (ii) Examine how residents feel they can contribute to improving the conditions;
- (iii) They can also study the impact of migration on the urban areas leading to the rise of slums because the population explosion is largely due to migration to the city;
- (iv) Data will show why people migrate to the city;
- (v) An interesting connection between the rural and urban areas can be drawn by looking at slums, and the nature of occupations found there.

#### 4. Biographical Sketches of one of the Thinkers - Weber, Comte, Srinivas, Ghurye, etc. (S. No. 9 - List of suggested assignments for Practical Work)

**Aim:** To present a simple overview of the thinkers and their primary contribution and see how students are able to apply practically what they have studied in class theoretically.

**Data:** Students must first choose a thinker they like.

Students will have to use secondary sources and what they have learnt in class to gather information. Other secondary source materials available in the library should be used, such as encyclopaedias. Information is also available on the internet.

**Interpretation:** From the available material, the student should:

- Present a brief biographical history of the thinker
- Discuss major theoretical contributions of the thinker
- Take an example to discuss the empirical application of anyone of the theoretical ideas attributed to the thinker.

For example, a student could do a sketch of Durkheim and his study of religion and then take the example of tribal religion to explain the concept of totems and clans. Or Marx's concept of the rise of communism can be discussed with the help of examples.

#### GUIDELINES FOR TEACHERS:

1. It must be emphasized that the process of doing the project is as important as the final project.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to prepare a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference material could be suggested by the teachers and made available to students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks must be awarded for content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.

## CLASS XII

There will be **two** papers in the subject:

**Paper I** - Theory: 3 hours .....70 marks

**Paper II**- Practical Work .....30 marks

### PAPER - I (THEORY) – 70 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (50 marks)** will consist of **eight** questions out of which the candidate will be required to answer **five** questions, each carrying **10 marks**.

#### 1. Social Institutions

(i) Definition and features of Social Institutions.  
Self explanatory.

(ii) Types of Social Institutions: Kinship, Marriage and Family

*Kinship: Meaning of kinship, Types of kinship: consanguineous and affinal kinship. Degree of kinship (primary, secondary, tertiary; descent (matrilineal, patrilineal); residence (matrilocal, patrilocal and avunculocal) discuss Kinship usages: avoidance, joking relationship, teknonymy, avunculate, amitate, couvade; also discuss descriptive and classificatory kinship terms.*

*Marriage: definition and functions.*

*Definition, merits, demerits, functions of the following:*

- *Rules of marriage: exogamy and endogamy (clan, gotra, pravara, village and sapinda), cross and parallel cousin, levirate, sororate, hypergamy and hypogamy.*

- *Forms of marriage: polygamy (polyandry and polygyny), monogamy.*

*Family: definition and features (MacIver's features); Functions of family to be discussed explaining the reasons for its universal existence.*

*Types of family: consanguineous and conjugal family (family of origin and procreation), matriarchal and patriarchal family (matripotestal, patripotestal and avuncupotestal), nuclear and joint families.*

*Structural changes (disintegration of the joint family), functional changes; Factors responsible for the changes. Small family norm.*

#### 2. Religion and Society

(i) Definition and concepts of religion and science; beliefs, rituals, superstitions, taboo.

*Definition of the above and a basic understanding of each of the above. Differences and similarities between religion and science.*

(ii) Theories of religion: animism, naturism, totemism, functional theories.

*A brief discussion of animism, naturism, totemism; functional theories (Malinowski, Radcliffe Brown and Durkhiem).*

(iii) Functions and dysfunctions of religion.

*A brief discussion on the positive and negative functions of religion.*

(iv) Communalism, fundamentalism and secularism in a plural society.

*Definition and features of each of the above, explanation through relevant examples showing how the State copes with the above crises to maintain Unity in Diversity.*

(v) Morality and social control.

*Definition of morality and social control; relation between religion, morality and social control, moral code, religious code.*

#### 3. Political Organization

Political Organization and its role in bringing about change in society.

*Definition of political organization; definition of Panchayati Raj (Village Panchayat, Block Samiti and Zila parishad – three tier, the 73<sup>rd</sup> Constitution Amendment Act, Bal Panchayats); discuss the role of the Panchayat in empowerment of women and children.*

#### 4. Economic Organisation

(i) Economic Organisation

*Definition of economic organization, economic and free goods.*

- (ii) Economies of Indian tribes: food gathering, agriculture, shifting axe cultivation, handicrafts, pastoralism, industrial labour.

*Economies of Indian tribes: (i) Food gathering; (ii) agriculture: shifting axe cultivation (jhum, dahi, koman, penda, podu and bewar), criticism of this type of cultivation, examples of tribes having this practice; (iii) handicraft making; (iv) pastoralism; (v) industrial labour - migration of large numbers of Santhal, Kond and Gond to tea gardens in the north east; large resources of coal, iron and steel in Bengal, Bihar and Madhya Pradesh; examples of Santhal, Ho in pick-mining, coal-cutting, the mica and the iron & steel industry.*

- (iii) Agrarian Economy, Jajmani system and Rural Employment.

*Agrarian Economy: land relations – owner, tenant, share cropper.*

*Jajmani system: caste based occupations and exchange of services.*

*A brief understanding of MGNREGA and its implications.*

- (iv) Traditional Markets

*To be discussed with respect to Weekly markets, barter exchange.*

## 5. Tribal India - Past, Present and Future

- (i) Definition of tribe, features and classification.

*Definition of tribe, features (unity and self-sufficiency, clan and family, common totemic ancestor, territory, occupation, endogamy, dormitories, language, common culture, common name, common religion, political organization and territory.); racial classification – mongoloid, caucasoid, australoid and negrito – to be explained with the help of examples along with the geographical location of tribes.*

- (ii) Dormitories in Tribal India

*Definition; origin of dormitories; features and functions; culture contact and change in dormitories.*

- (iii) Contact of tribes with wider society (assimilation, acculturation and isolation; tribal transformation).

*Definition and examples of assimilation, isolation and acculturation; an understanding of how these processes have helped in tribal transformation.*

- (iv) Present conditions, problems and solutions.

*Economic, political (regionalism and separatism), social and cultural conditions and problems.*

*Discuss briefly the following policies of the Government of India (post independence) for upliftment of the Indian tribes: Tribal Panchsheel, important constitutional safeguards: important Committees and Commissions: Backward Classes Commission; Special Central Assistance; Economic programmes and facilities: Integrated Rural Development Programme (IRDP); Large Sized Multi-Purpose Cooperative Societies (LAMPS); 20 Point Programme; Programme for encouragement in crafts, home industries and agriculture; Educational policies.*

## 6. Social Stratification

- (i) Social stratification: the elements.

*Definition of social stratification, features, inequality, difference.*

- (ii) Class: The class system: its nature, development, types of classes.

*Discuss briefly the growth, nature of the different classes (lower, middle, upper).*

- (iii) Caste: The caste system: concept, caste origin, caste and class comparison, its features; caste in modern India.

*Definition; Theory of Divine Origin; characteristics of caste.*

*Social mobility - brahminisation, sanskritisation and westernization - definitions only.*

*Caste in Modern India –*

- *Changes in the role and features of caste (relevant examples may be given to provide a better understanding for e.g. the role of the dominant caste).*
- *Factors leading to change in the caste system:*

*Influence of education, industrialization, urbanization, modernization, freedom struggle and the establishment of Democracy, rise of the Non –Brahmin movement, other causes - social reform movement, threat of conversion, improvement in the status of women and rise of new classes; Social legislation {a brief mention to be made of the following Constitutional Measures: Caste Disabilities Removal Act (1872), The Hindu Marriage Act (1955), The Untouchability Offences Act (1956), Constitutional policy of protective discrimination, the Kaka Kalelkar Commission (1953), The Mandal Commission (1979)}.*

(iv) Race and Ethnicity

- Concept of race and racism.  
*Definition and traits of race and racial prejudice.*
- Notion of Ethnicity  
*Definition and features of ethnicity*
- Relationship between race and ethnicity:  
*Causes of prejudice: misinformation, ethnocentrism and xenophobia, economic advantages, political advantages; a brief mention of conflict between ethnic communities.*

(v) Gender: Difference between sex and gender, patriarchal ideology and the status of women in independent India.

*Difference between sex and gender, gender bias and its consequences for both men and women – at the workplace, property rights and family status.*

*Gender issues: female infanticide, foeticide, dowry, sati, child marriage, domestic violence, rape, widowhood, sexual harassment; women as perpetrators of violence.*

*The following bills and latest amendments to be briefly discussed: The Anti-Dowry Act; the Anti-Rape Bill, the Inheritance Bill, Domestic Violence Act.*

## 7. Social Change and Development

(i) Social change and Development

*Definition of Social Change and development – features and sources.*

(ii) Aspects of Development

*Industrialization, urbanization, modernization, globalization and sustainable development - definitions and their role in social change.*

*The relationship between social change and development, (special focus on sustainable development, ecological and environment issues for improving quality of life for the present and future).*

(iii) Social Movements: Meaning, causes and their role in society.

*Meaning, causes, consequences and role of the following Social Movements in society - the Maoist Movement in Chhatisgarh (Tribal movement), Irom Sharmila (a feminist struggle in Manipur), the Telangana Movement (An Urban-ethnic movement which began as a tribal movement in the 19<sup>th</sup> century).*

(iv) Role of Education in creating Social change.

*Meaning and functions of education. Emphasize the role of education in creating social change. Role of Right to Education (RTE) and its implications to be discussed briefly.*

(v) Role of Mass Media in creating Social change

*Role of Mass Media (Print, electronic, audio-visual; positive and negative aspects of mass media). Understanding each of the above forms of mass media and their role in creating social change; their role in creating a civil society that confronts the bureaucracy and the authoritarianism of the state machinery through NGO activity, vigils and acts like the Right to Information (RTI).*

*Positive and negative aspects of mass media.*

## PAPER II (PROJECT WORK) – 30 MARKS

To do justice to the basic structural principles and theoretical orientation of the discipline, empirical and ethnographic substantiation is essential. In keeping with the significance of doing practical work and gaining a hands-on understanding of various social issues, candidates are expected to undertake **two studies**. Topics for the studies should be chosen from within the overall syllabus as there is ample scope for diversity.

Candidates will be expected to have completed **two studies** from any chapter covered in Theory. Assessment for each study will be as detailed below:

**The practical work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation **per study** [15 marks] will be as follows:

1	Evaluation by the teacher	5 Marks
2	Evaluation by the Visiting Examiner	10 Marks

### Evaluation by the Teacher:

S. No.	Assessment objective	Criteria	Marks
1.	Process	Candidates should be able to: Identify the topic. Plan and detail a research project. Select and use appropriate research methods.	1
2.	Understanding, application of knowledge and Analysis	Candidates should be able to: Explain issues and themes clearly and in context. Interpret, analyse and evaluate critically a range of evidence to present reasoned, substantiated arguments/statements.	2

3.	Presentation	Overall format, referencing (footnotes &/or bibliography), within word limit of 2000 words, title page, header/footer, etc.	2
<b>TOTAL</b>			<b>05</b>

### Evaluation by Visiting Examiner:

S. No.	Assessment objective	Criteria	Marks
1.	Choice of Technique/ Detailed procedure & Presentation	Candidates should be able to: Overall format, referencing (footnotes &/or bibliography), title page, header/footer, etc.	4
2.	Analysis and evaluation	Candidates should be able to: Interpret, analyze and evaluate critically a range of evidence to present reasoned, substantiated arguments/statement.	3
3.	Viva	Range of questions based on the project only.	3
<b>TOTAL</b>			<b>10</b>

### List of suggested studies for Project Work:

1. Different types of kinship systems (patriarchal/matriarchal with examples as the base of discussion).
2. Different marriage customs in India (comparisons can also be done).
3. Changing nature of the Indian family.
4. Religion and Society (focus can be on the biography of a world religion).
5. The problem of Communalism in India.
6. Traditional economies and the barter system.
7. Consumerism and modernization.
8. The status of women in traditional society.
9. The changing status of women in India.

10. Women Leaders.
11. The role of Education in creating social change.
12. Media and modernization.
13. The internet as a substitute for family and school.
14. Globalisation and its impact on the individual and society.
15. Social Movements (focus on the biography of a movement that is based on the efforts of a caste/tribe/women/religious group / class or connect two aspects, for example, the Narmada Bachao Andolan is a tribal movement and has a woman as its leader in Medha Patkar).
16. Role of society in development and environment – (public awareness, education programmes, campaigns, public participation in decision-making, etc. e.g. Chipko Movement, Appiko in Karnataka, Eco Clubs, etc.
17. Study a few noteworthy examples of sustainable development e.g.- Barefoot College in Tilonia, the work of NGOs like DDS in Andhra Pradesh in promoting self-sustenance in rural communities through developing seed banks, cultivation of millets and through promoting microfinance in the Grameen bank model.
18. The policy of reservation in India or The Backward Class Movement.
19. The significance of the Mandal Commission.
20. The rising Middle Class in India.
21. The nature of protest in rural India (example Singur).
22. Race and examples of Racism (Apartheid/ American Racism).
23. The birth of new states in India based on ethnic separatism.
24. The Uttarakhand tragedy: natural or manmade disaster?
25. Superstitions and Taboos.

*The studies chosen are primarily theoretically oriented and based on concepts learnt in the class. Because these studies are theoretical, the methodology will be different and would be based on secondary data collection and its analysis and interpretation. Broad suggestions about how to approach similar studies are given below:*

### 1. Changing nature of the Indian family (S. No. 3 - List of suggested assignments for Practical Work)

**Aim:** To study the changing nature of the family in an urban setting.

**Data:** Students need to identify their sample and then gather their data by interviewing members from five families. Members of different generations from each family should be interviewed.

The student needs to collect data with the help of a questionnaire and interviews. The questions can be framed on the following:

- Description of the family structure (members, who does what in the family, the jobs outside, etc.)
- How they see themselves – joint or nuclear in terms of family relatives, who all live together, or share a kitchen or pool resources, etc.
- Seeking different family members opinion on whether they feel family life has changed. Nature of changes that have taken places and what have caused the changes.
- Has the status of the women in the family has changed in the recent past.
- Whether the women in the family work?
- Relationship between the different members of the family.

**Interpretation:** Once students have gathered this information they can analyse whether the family they have interviewed has changed over a period of time.

Students should examine:

- whether the respondents' perception of the nature of the family matches with what the student has learnt in class.
  - analyse what are the reasons for change in the nature of the family, if any.
- For instance:
- (i) whether migration has caused the family to change
  - (ii) occupational changes and shift in residence has caused changes.

- (iii) the education and working of the women of the family has created changes
- (iv) failure of the generations to cope with each other has led to changes
- (v) constraint of space has caused the changes

**Conclusion:** Students should also do a minor statistical analysis of:

- the types of families that they are able to identify into nuclear and joint
- make an approximation about what type of family is the trend in their sample.
- proceed to find out whether there are common factors in their sample that keep a family nuclear or joint.

**2. Consumerism and Modernization (S. No. 7 - List of suggested assignments for Practical Work)**

**3. Media and Modernization (S. No. 12 - List of suggested assignments for Practical Work)**

**4. Globalisation and its impact on the Individual and the Society (S. No. 14 - List of suggested assignments for Practical Work)**

These three topics are interrelated and yet can be looked at independently.

*(The same aim, methodology and interpretation will apply for the above studies).*

**Aim:** To discuss how the processes of modernization and globalisation have had an impact on society, culture and the individual.

**Data:** Students need to interview members of a family from different generations (grandparents /parents and grandchildren/children) by identifying a sample of families in their neighbourhood who could belong to different economic backgrounds. Data should also be gathered from secondary sources such as the newspaper, internet and magazine articles.

Students need to begin by first discussing the concepts of modernization and globalisation as learnt in class. They should then proceed to gather information on consumerism, media and the changes in a society as a result of the process of globalisation.

Students need to ask these respondents:

- Nature of their life style
- Patterns of expenditure
- How they use their leisure time
- Students should then ask how this is different from the earlier times so that they get a sense of the change in the lifestyle
- How their daily life has changed with modernization
- What is the nature of the change
- Ask respondents what role the media has played in bringing about change and adaptation
- Ask about the role of the market in influencing consumption
- How their consumption patterns have changed
- How their thinking has changed and what are their political leanings
- Whether these are positive or negative changes

**Sociological interpretation:** Students need to do a simple analysis of the patterns of change and the reasons for the change.

They should also see if there is a common pattern in the classes of this change.

They should try and compare the changes between classes and understand if factors such as:

- education
- income
- family background
- religion etc., play a role in the changing life following modernization and globalisation.

**5. Internet as a substitute for the Family and School (S. No. 13 - List of suggested assignments for Practical Work)**

*This topic is self-evident and requires a critical analysis of the positive and negative impact of the internet. Given the amount of time the youth spend on the internet, it would be interesting to let the students engage in an auto- biographical critical analysis of the topic.*



*The analyses could be presented as a debate of ideas, supported by interviews with family members, parents, teachers and peers.*

**6. Social Movements (S. No. 15 - List of suggested assignments for Practical Work)**

**Aim:** This topic requires students to discuss what social movements are and the ideology behind them, supported by a case study of a social movement.

**Data:** The data would have to be gathered from secondary sources such as the Internet, magazines and newspaper archives.

Students should choose a particular movement from what they are taught. For instance, they can look at the Dalit Movements, tribal movements, environment movements, the Maoist insurgency, anti-price rise agitations, Chipko/Narmada Bachao, etc. Having done so, they can choose to present a case study of a significant contemporary social movement either in the rural or the urban context.

**Interpretation:** Students need to present the:

- History
- Purpose &
- Achievements

They also need to present the community and individual significance of the movement.

Students should also be able to trace out the role of a pivotal figure in the movement. For instance the role of Ambedkar in the Dalit Movement or the role of women in the Chipko movement, Medha Patkar in the Narmada Movement

**7. Changing status of women in India (S. No. 9 - List of suggested assignments for Practical Work)**

**8. Women Leaders (S. No. 10 - List of suggested assignments for Practical Work)**

**Aim:** These two topics are meant to understand whether the position of women has changed in society

**Data:** For both the topics, students would be required to take up specific areas where women participate. For instance, the role of women in the economy or women in education or women in the public arena can be looked at.

**For topic 9 (Changing status of women in India):** Students can interview women in these areas and ask questions such as:

- how their lives have changed socially and economically
- how their status has changed
- how education has changed their lives
- what they see as symbols of this change

Students should also have a summary of the Government's legislations/bills on women, as this will help analyse how successful the Government's efforts have been at emancipating women.

A comparison between the past and present can also be done by the students.

**For topic 10 (Women Leaders):** After following the above aim and data, students should take up the life of a woman leader from any time frame and present a biographical sketch supported by photographs.

They can also take up the life of two women from two different time periods and compare the changes that have taken place.

Case studies of women in different arenas, across cultures/religions can be presented.

**9. The rising Middle Class in India (S. No. 20 - List of suggested assignments for Practical Work)**

**Aim:** To study the rise of the middle class and its changing lifestyle, consumption habits and mindset.

**Data:** Students will have to gather data by interviewing middle class family members in their neighbourhood. Students need to interview members of a family from different generations (grandparents /parents and grandchildren/children).

They need to create a questionnaire for this where the kind of questions asked should be:

- About family background (age /religion, etc.).
- Their history in the city (how long they have lived there /where they have come from/why they came, etc.).

- Their past and present occupation.
- Income levels.
- Patterns of expenditure.
- What are the gadgets they use
- The car they drive.
- How they use their leisure time.
- Their opinion on careers for their children.
- Where they go for holidays.
- What are their political leanings

Students should then ask how this is different from the earlier times so that they get a sense of the change in the lifestyle.

**Sociological interpretation:** A major focus of the questions asked would have to be on the changing consumption patterns of the household. This would enable students to analyse not only changes in the consumerism of the class but also understand how mobility is closely related to class.

Students should be asked to read about the changing role of the middle class through India's history in the political arena.

#### 10. The birth of New States in India based on Ethnic Separatism (S. No. 23 - List of suggested assignments for Practical Work)

**Aim:** To study the relationship between nation, ethnicity and separatism with the help of examples and to discuss the importance of ethnicity in the formation of identity using the examples.

**Data:** Secondary sources of information such as news magazines and the internet can be used after a state has been identified for study.

##### **Sociological Interpretation:**

- (i) It is important here to try and make students aware of the contemporary relevance of these issues
- (ii) Students should take the example of a recently formed state in India, such as: Jharkhand, Chattisgarh or the demand for Telangana.
- (iii) They should discuss how the state was formed.

(iv) They should also analyze the importance of ethnic identity in the demands for separate statehood.

(v) They should examine how this demand for a separate state can threaten the unity of India. For instance, as is being seen in Assam, Kashmir and even Mumbai.

(vi) They can also examine the history of such separatism by looking at how and why states like Tamil Nadu or Andhra Pradesh were formed.

Finally based on the example they chose, students should attempt to say something about how ethnicity can threaten the idea of a nation because it can be the basis of sub nationalism on one hand and separatism on the other.

#### **GUIDELINES FOR TEACHERS:**

1. It must be emphasized that the process of doing the project is as important as the final project.
2. Once the project/projects are chosen, there should be a process of brainstorming to encourage students to make out a draft/structure for the project before embarking on research.
3. During the brainstorming/discussion, the teacher should discuss the assessment criteria with the students.
4. The teacher should discuss the draft with the student with regard to the central question and the type of sources to be used.
5. The students should be guided on doing the research and looking at different types of evidence.
6. Books and suitable reference material could be suggested by the teachers and made available to the students.
7. Internet sites could be suggested, but care must be taken in selecting, using and citing these sites.
8. Students must be cautioned against plagiarism and be penalized for the same.
9. Marks must be awarded for content and originality and not for decorative elements and embellishments.
10. Projects must be the original work of the student.

# PSYCHOLOGY (855)

## Aims:

(i) To develop an understanding of human behaviour: the nature of individuals and of members of social groups.

(ii) To develop an understanding of the methods of research and study employed in Psychology.

(iii) To develop an appreciation of the practical value of Psychology and its applications in daily life.

## CLASS XI

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....70 marks

**Paper II- Practical Work:**.....30 marks

### PAPER - I (THEORY) – 70 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions relating to the fundamental aspects of the entire syllabus.

**Part II (50 marks)** will consist of **two** sections, A and B.

Candidates will be required to answer **two** out of **three** questions from Section A and **three** out of **five** questions from Section B. Each question in this part shall carry **10 marks**.

### SECTION A

#### 1. The Subject Psychology

- (i) Definition of Psychology; Nature – bio science, social science or pure science; schools of thought – Structuralism, Functionalism, Behaviourism, Psychoanalysis, Gestalt psychology.

*Definition of Psychology, meaning of the terms behaviour, stimulus and response. Subject matter / nature of Psychology as a bio science, social science or pure science. The eclectic approach of modern Psychology. Main features of the schools of Structuralism, Functionalism and Behaviourism, Psychoanalysis, Gestalt psychology (two Psychologists of each approach and their relevant concepts).*

- (ii) Fields of Psychology – clinical, counselling, developmental, educational, organizational and social.

*The general importance and aims of studying Psychology and its special benefits. Applications - different branches and the kind*

*of work done in special fields - clinical, counselling, developmental, educational, organizational and social (in brief).*

- (iii) Heredity and Environment – meaning of the term ‘heredity’; basic principles and mechanism of heredity (genetic). Meaning of the term ‘environment’; importance of both heredity and environment in behaviour.

*The definition and role of chromosomes and genes (dominant and recessive); the laws of heredity: uniformity and variability. Significance of environment: physical and social. Heredity related diseases: Mental Retardation and Huntington’s disease. How both heredity and environment interact to produce behaviour (Twin studies, Adoption Studies, Separated Twin Study).*

#### 2. Methods of Psychology

- (i) Scientific Methods in Psychology - observation, case study, surveys, psychological tests, experimentation – steps. Psychological tests and their uses.

*The application of scientific methods in the study of behaviour. What is meant by scientific observation? Field study; controlled and uncontrolled observation; longitudinal and cross-sectional studies; the case history method; the experimental method - variables and controls - steps in an experiment; surveys and use of questionnaires/self-reports. One advantage and one disadvantage for each method of Psychology. Meaning of samples (random, biased, representative); meaning of population. Psychological tests – characteristics, definition, uses and types.*

- (ii) Interpretation of research results – use of statistics in interpretation of data -

understanding of why statistics is used (descriptive & inferential). Basic statistical concepts – statistics, sample, population.

*Why statistics is used in Psychology - interpretation of findings: describing and summarizing data, comparing individuals/groups, investigating relationships between variables, predicting. Descriptive statistics - for summarizing scores. Inferential statistics - to determine whether observed differences between groups are likely/unlikely to have occurred by chance.*

*How scores are grouped into frequency distributions; central tendency of a frequency distribution - mean, median, mode and when each measure is used; dispersion: the extent to which scores are spread out - range, variance, standard deviation; why both central tendency and variability are important in psychology.*

### 3. Attention and Perception

- (i) Nature of attention - its inner and outer determinants.

*The importance of attention in perception - how both physical factors such as size, colour, movement, change, intensity, contrast and psychological factors such as need, interest and emotion determine attention and perception.*

- (ii) Perceptual processes - difference between sensation and perception. Organizational principles of perception - laws, constancies, depth and colour perception.

*Process involved in transforming sensation to perception. Important factors in perceptual process - figure and ground, laws of grouping: similarity, proximity, continuation, simplicity, good figure; constancy of size, shape, colour and brightness; factors involved in depth perception -monocular and binocular cues; how colour is perceived - biological and psychological factors ; attributes of colour - hue, wavelength, brightness and saturation; laws of colour mixture; colour blindness, adaptation and after-images.*

- (iii) Errors in perception - illusions of size and shape; what is meant by extra-sensory perception (ESP).

*False interpretations - illusions: Muller-Lyer, Height -Width, Ponzo, Zoellner, Poggendorf (details of experiments are required); ESP -*

*perceptions not based on any of the known senses (general understanding of ESP).*

## SECTION B

### 4. Emotions and Motivation

- (i) What is meant by emotion; the basic emotions.

*Subjective and cognitive experience, physiological basis of emotion, reactions and overt expression. Primary emotions - fear, anger, joy, sorrow, affection, physiological basis of emotion.*

- (ii) Theories of emotion dealing with physiological, subjective and cognitive aspects.

*James Lange, Cannon Bard, Schachter - Singer theories.*

- (iii) What is meant by motives, needs and instincts.

*Motivation as an internal force generating certain behaviour - biological needs and homeostasis; instincts as unlearned and physiological desires; evidence indicating the existence of unconscious motives. Intrinsic - the desire to perform activities for their own sake.*

- (iv) Theories of Motivation.

*Pull and push theories, Optimum Arousal theory and Expectancy theory - Graphic representation of Maslow's Needs Hierarchy.*

- (v) Social motives.

*Three distinctively human motives: Achievement - accomplishing difficult tasks; Power - exerting influence over others; Aggression - learning and control of human aggression, causes and effects.*

- (vi) Frustration - blocking of motives; conflict among motives.

*Frustration as a result of motives not finding free or adequate expression. Different types of conflict among motives: approach-approach, avoidance-avoidance, multiple approach-avoidance (with examples).*

### 5. Learning

- (i) What is meant by learning; how learning takes place - Classical and Operant Conditioning; Insight learning, Observational Learning and Learning Styles.

*Definition of learning - Pavlov and Classical Conditioning; Thorndike and Trial and Error; Skinner and Operant Conditioning; experiments, findings and principles established. Insight and Observational Learning - Kohler and Bandura's studies. Learning Styles – Auditory, Visual and Kinesthetic.*

- (ii) Learning disabilities: definition and types.

*Characteristics of the disabilities - Dyslexia, dyscalculia, dysgraphia, dyspraxia (symptoms and management). Adjustment problems and remedials.*

## 6. Remembering and Forgetting

- (i) The memory system - how it works - different models.

*Sensory memory, Short and Long term Memory - encoding, storage, retrieval. Terms like iconic image, free recall, serial position effects, recency effects, primary effects, episodic, working memory. Semantic and Procedural Memory. Processing memory - the Atkinson Shiffrin Model and Parallel Distributed Processing.*

- (ii) Why and how forgetting occurs.

*Trace decay, retro and proactive interference, retrieval failure, amnesia - retrograde and anterograde; Alzheimer's disease; Dementia.*

- (iii) How memory can be improved.

*Attention, use of imagery, Mnemonic devices, application of principles of learning.*

## 7. Thinking, Problem Solving and Creativity

- (i) What is meant by thinking.

*Definition and basic elements of thought. Nature and elements of thinking: images, visual image, concepts and language - interdependence of language and thought; different kinds of thinking: convergent, divergent, creative, goal-oriented and aimless thinking.*

- (ii) Concepts and how they are formed.

*Definition - importance of concepts in thinking - artificial, natural, simple and complex concepts.*

- (iii) Reasoning - how it is carried out; common errors in reasoning, how reasoning can be

made more effective. Decision making and problem solving - heuristics and algorithms.

*Reaching specific conclusions from available information - deductive and inductive reasoning; common errors - faulty premises, biases, fallacy of single case, rationalization, hindsight. Improving reasoning - avoiding errors, examining premises and ambiguities, guarding against emotion. Decision Making and Problem Solving - steps involved, optimum expected utility, means-end-analysis, analogy.*

- (iv) Creative thinking - what is meant by convergent and divergent thinking; stages in creative thinking, how creativity can be fostered.

*Use of divergent thinking in creativity - stages in creative thinking, preparation, incubation, illumination, verification/validation. How creativity may be encouraged: enrich knowledge and experience, encourage independence, curiosity and promote positive mood.*

## PAPER - II (PRACTICAL WORK) – 30 Marks

Candidates will be expected to have completed **two** studies / experiments from any chapter covered in Theory. Assessment will be based on a written report which should cover –

- (I) Aim  
 (II) Basic concept: Definition of concepts used and related theory. Identification of variables – independent and dependent.  
 (III) Method - (i) Sample of the Study  
 (ii) Procedure followed (data-collection, nature of raw data)  
 (iii) Treatment of Data  
 (iv) Results & Discussion  
 (v) Conclusion

### (IV) Bibliography

Mark allocation **per study** [15 marks]:

Basic Concept	3 marks
Method (correctness of procedure)	4 marks
Results and discussion	4 marks
Viva	4 marks

## CLASS XII

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours ...70 marks

**Paper II- Practical Work:** ...30 marks

### PAPER - I (THEORY) – 70 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions relating to the fundamental aspects of the entire syllabus.

**Part II (50 marks)** will consist of **two** sections, A and B.

Candidates will be required to answer **two** out of **three** questions from Section A and **three** out of **five** questions from Section B. Each question in this part shall carry **10 marks**.

### SECTION A

#### 1. Intelligence and Ability

- (i) Intelligence: what is meant by intelligence - theories regarding the nature of intelligence; how intelligence is measured - the concept of IQ, intelligence tests – Individual Tests, Group Tests, Culture Fair Tests. Levels of intelligence and associated characteristics. Emotional Intelligence (EQ). Creativity.

*Intelligence: definition of intelligence (David Wechsler); what is meant by intelligence - theories regarding the nature of intelligence; Theories of Intelligence: Two Factor Theory – Charles Spearman; Primary Mental Abilities – Thurstone; Raymond Cattell – Fluid and Crystallised Intelligence; Guilford’s Structure of Intellect Model. Modern Theories: Information Processing; Triarchic Theory – Sternberg; Theory of Multiple Intelligence – Howard Gardner. How intelligence is measured - the concept of IQ; Intelligence Tests – Individual Tests - Stanford Binet, Wechsler, Group Tests – Raven’s Progressive Matrices, Culture Fair Tests – Cattell’s Culture Fair Test. Test details (Aim, history, description, scoring and uses) should be included; Levels of intelligence and associated characteristics (from gifted to below average). Emotional Intelligence (EQ) - Characteristics of*

*Emotionally Intelligent Persons. Creativity and Intelligence.*

- (ii) Aptitude, Achievement and Interest: meaning of these terms. Reason for their assessment and means of assessment (different tools/ tests) used.

*What is meant by Aptitude - when aptitude needs to be assessed - the GATB (General Aptitude Test Battery); meaning and usefulness of Achievement tests; why and how Interest is measured - the SCII (Strong Campbell Interest Inventory).*

#### 2. Personality

- (i) What is meant by Personality.

*Definitions of personality – Allport, Cattell, Eysenck.*

*Personality related terms: Temperament, Trait, Disposition, Character, Habit, Values, Concept of self.*

- (ii) Theories of Personality: Type Theories, Psychoanalytic Theory - Freud’s structure of personality; psycho-sexual stages of development; Post Freudians (in brief); Humanistic - Rogers and Maslow; Traits - Allport, Cattell; Social/Behavioural Learning - Bandura and Rotter.

*Type Theory: Sheldon, Kreshtmer, Hippocrates, Friedman, Psychoanalytic Theory of Personality: Freud's levels of consciousness, structure of personality - Id, Ego and Superego; principles on which they function; Psychosexual stages of development and fixation; Post Freudians: Erik Erikson, Horney; Humanistic theories of Rogers (concept of fully functioning persons) and Maslow (self actualization). Traits: Allport (central, secondary and cardinal traits), Cattell (source and surface traits). The five-factor model of Costa and McCrae. Social Cognition and Social Learning theories of Bandura and Rotter (Identification and explanation of concepts in each theoretical framework).*

- (iii) How personality is assessed: reports, inventories (MMPI), projective techniques - Rorschach Inkblot Test and Thematic Apperception Test, Behavioural Analysis.

*The use of Self Reports - inventories/questionnaires in assessing Personality - an understanding of the MMPI (Minnesota Multiphasic Personality Inventory); what is meant by Projective Techniques - how the Rorschach Inkblot and TAT (Thematic Apperception Test) are used (Test details should include procedure, scoring and results).*

*Behavioural Analysis: Interview, Observation, Nomination, Behavioural ratings, Situational tests.*

## SECTION B

### 3. Lifespan Development

- (i) Meaning of Development, growth and maturation.

*Why is the study of lifespan development important? Determinants – interaction of heredity and environment, context of development – Bronfenbrenner’s Ecological System Theory.*

- (ii) Infancy - motor, cognitive development, socio-emotional development.

*Motor – milestones; cognitive – Piaget’s Sensory Motor Stage; socio-emotional development – emergence of attachment. Mary Ainsworth’s & Lamb’s strange situation test.*

- (iii) Childhood - motor, cognitive development, socio-emotional development.

*Motor development; cognitive development – Piaget’s Theory (Preoperational and Concrete); emergence of self – gender awareness, gender identity, stability, consistency, stereotype role, sex-category, constancy; Emergence of peer relationship. Moral development – Kohlberg’s perspective Experiment on Moral Dilemma – pre-conventional, conventional and post conventional morality.*

- (iv) Adolescence - physical changes, cognitive development, socio-emotional development; some major concerns.

*Physical changes at puberty; Cognitive development – Piaget’s Formal Operational Stage; Socio-emotional development - forming an identity, dealing with sexuality and gender identity; some major concerns – delinquency, substance abuse (drugs and alcohol) – meaning of substance abuse, symptoms and treatment; eating disorders - bulimia, anorexia.*

### 4. Stress and Stress Management

- (i) Meaning of stress - its basic nature.

*Strain and Eustress; Types of stress-psychological, physical and environmental; Stress as a process - stressors (negative and positive events); results of overload; the stages of GAS or the General Adaptation Syndrome (Selye’s model). Cognitive appraisal of stress – primary and secondary.*

- (ii) Common causes of stress.

*External/situational: major life events, minor hassles of everyday life, work-related causes, the physical environment.*

*Internal/dispositional: Personality variables-traits and types.*

- (iii) Effects of stress on health and performance.

*Upsets the internal mechanism and balance - immune system affected, hypertension, heart problems, ulcers, diabetes, asthma (each effect to be briefly explained). Relation between stress and performance - burnout.*

- (iv) Stress management - ineffective and effective strategies of handling stress.

*Coping with stress: Ineffective strategies - defence mechanisms - rationalization, projection, reaction formation, regression, repression (each to be briefly explained), displacement, sublimation; Effective strategies - relaxation training and yoga. Effective lifestyles: stress cycles – distress and wellness.*

*Promoting positive health and well-being: Exercise, Diet, Self-Care, Life Skills, Assertiveness, Rational thinking, improving relationships, overcoming unhelpful habits, Social support, Stress Resistant Personality, Positive thinking and attitude.*

## 5. Psychological Disorders and Psychotherapy

- (i) Meaning of “Abnormal behaviour” - biological, psychological and socio - cultural perspectives. Principles of classification of psychological disorders with reference to DSM IV.

*Common features of abnormal behaviour-deviance, distress, dysfunction, danger.*

*Different views of "abnormal" behaviour - the statistical stand - the biological/medical approach - the psychodynamic perspective - the sociocultural dimension; why classification of disorders is necessary - an understanding of the Diagnostic and Statistical Manual of Mental Disorders – IV (brief explanation of each Axis).*

- (ii) Characteristics of some psychological, behavioural and developmental disorders: Anxiety - generalised, phobic, obsessive-compulsive; Mood - bi-polar, depression; personality - anti-social, histrionic, avoidant, dependent, passive-aggressive (causes and symptoms of all).

*What is meant by anxiety - different forms of anxiety disorders: phobias, obsession - compulsive disorders; Mood disorders-characteristics of severe depression, manic-depressive or bipolar disorder; personality - anti-social, histrionic, avoidant, dependent, passive-aggressive (causes and symptoms).*

*Behavioural and Developmental Disorders-Attention Deficit Hyperactive Disorder (ADHD), Conduct Disorder, Autism, Separation Anxiety Disorder.*

- (iii) Schizophrenia - meaning; main types; characteristics.

*Basic nature of Schizophrenia - characteristics of Disorganized Catatonic and Paranoid Schizophrenia (symptoms).*

- (iv) Psychotherapy - Psychoanalysis; Client-centred; Behavioural. Social Rehabilitation.

*What is meant by Psychotherapy - central features of psychodynamic therapies - free association, dream analysis, transference and counter transference; the principles on which client centred therapy has been developed. Behavioural therapies based on classical and operant conditioning and modelling, social rehabilitation. Cognitive Behaviour Therapy.*

## 6. Social Thought and Social Behaviour

- (i) Social Perception - attribution or the process through which people try to understand the reasons for others' behaviour.

*How people determine whether others' behaviour is a result of internal causes or external factors - biases in forming judgments (attribution). Explain with examples each of the following biases - the person positivity bias, motivational biases, self-serving bias, the false consensus effect, automatic vigilance, motivated scepticism, counterfactual thinking.*

- (ii) Social Influence- how people try to change others' behaviour; social norms; conformity and obedience - factors affecting them.

*Meaning and characteristics of a group; types of groups, formation of a group, influence of group on individuals; Meaning of social norms - why people conform to social norms and why they digress; factors affecting Conformity and Obedience. Asch's study on conformity; why and when people obey others - Milgram's experiment.*

## 7. Attitudes

- (i) Meaning of “Attitude” - the relationship between attitude, perception, belief and behaviour; how attitudes are formed and changed.

*What are attitudes - the components of attitude; how far attitudes determine behaviours: the process of forming attitudes - how attitudes change: persuasion and cognitive dissonance.*



- (ii) Prejudice – meaning of “prejudice” and discrimination; the origins of prejudice; how to combat prejudice.

*An understanding of the meaning of prejudice and how it works in the form of discrimination - causes of prejudice: social learning, realistic competition, social categorization and stereotyping; ways in which prejudice can be resisted.*

## 8. Applications of Psychology

- (i) Clinical and Counselling Psychology.

*Role of a counsellor and a clinical psychologist in dealing with individuals, couples, families and groups.*

- (ii) Educational (School) Psychology.

*How Psychology helps to facilitate learning in school - students and teachers; individual problems: learning differences, teaching and evaluation techniques, school environment. Career counselling - how Psychology helps in the choice of a career - requirements of a field or job, testing individuals, matching individual and field/job.*

- (iii) Organisational Psychology.

*How Psychology helps to promote efficiency, well-being and profitability - study of factors involved. Recruitment, motivation, team building and leadership skills, marketing and consumer behaviour.*

- (iv) Crime

*How Psychology helps towards: understanding criminals, rehabilitating them, preventing crime.*

### PAPER II (PRACTICAL WORK) – 30 Marks

Candidates will be expected to have completed **two** studies from those given below. Assessment will be based on a written report which should cover –

- (I) Aim  
 (II) Basic concept: Definition of concepts used and related theory. Identification of variables – independent and dependent.  
 (III) Method - (i) Sample of the Study  
 (ii) Procedure followed (data-collection, nature of raw data)  
 (iii) Statistical Treatment of Data

- (iv) Results & Discussion

- (v) Conclusion

**The practical work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation **per study** [15 marks]:

Basic Concept	3 marks
Method (correctness of procedure)	4 marks
Results and discussion	4 marks
Viva	4 marks

### A. Statistics

To study group differences in Examination results.

Groups: Any two classes or two sections of the same class with same subjects.

Raw Data: Summated scores on all subjects in the annual examination for each student.

Analysis:

- (i) Group analysis – Calculate mean scores (central tendency) and standard deviations (variability) for each group and make inter-group comparisons.  
 (ii) Individual analysis – Calculate Z (standard) scores for any two students from each class – one whose examination score is above the class mean and one whose examination score is below the class mean. Interpret the Z score in standard deviation units and indicate the percentage of scores that lie above/below the subject’s score (use a table that gives the areas under the Normal curve corresponding to given values of Z).  
 (iii) Graphic Representation – bar diagram to depict the mean scores of both groups.

### B. Attitudes

To study attitudinal differences regarding any one of the following – Fashion, Work/Lifestyle, Marriage.

Groups: Two generations (parents and children)

**Or**

Gender differences (boys and girls) of the same age-group (preferably from Class XI or XII).

Tools: to construct a simple 5-point scale (10-15 items) with positively and negatively worded statements.

Raw Data: Summated scores on all the statements for each respondent.

Analysis:

- (i) Calculate mean attitudinal scores for each group and make inter-group comparisons.
- (ii) Short, structured interview schedule constructed and administered to 8-10 students in each group. The responses elicited can be used to draw inferences to explain the inter-group differences, if any.

### **C. Stress**

To study the causes and effects of stress among school students.

Group: Class X or Class XI students

Tools: To construct two checklists - one indicating the potential stressors along with a 5-point rating scale indicating their frequency of occurrence (very often, often, sometimes, rarely, very rarely). The stressors should include dispositional/internal variables (personality attributes, cognitive appraisal) and situational/external variables (life events, environmental pressures – physical, social, cultural and academic stressors).

The second checklist should indicate the effects of stress (strain) – physical, psychological and behavioural along with their frequency of occurrence (on a 5-point rating scale).

Analysis: To determine the stressors and the effects that occur with the most to the least frequency and understand/explain each.

**NOTE:** No question paper for Practical Work will be set by the Council.

# ECONOMICS (856)

## Aims:

1. To enable candidates to acquire knowledge (information) and develop an understanding of facts, terms, concepts, conventions, trends, principles, generalisations, assumptions, hypotheses, problems, processes, etc. in Economics.
2. To acquaint candidates with tools of economic analysis.
3. To develop an understanding of important economic problems.
4. To acquaint candidates with the main institutions through which the productive process is carried out.
5. To develop an understanding of the role of institutions in the functioning of an economy.
6. To enable candidates to compare their own economic structure with that of the other areas of the world.

## CLASS XI

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II- Project Work** .....20 marks

### PAPER - I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions out of which candidates will be required to answer **five** questions, each carrying **12 marks**.

**Note:** The syllabus is intended to reflect a study of the theory of Economics with specific reference to the Indian Economy. Therefore, examples and specific references to the Indian Economy must be made wherever relevant.

### 1. Understanding Economics

- (i) Definition of Economics: Adam Smith, Alfred Marshall, Lionel Robbins, Samuelson.  
*Basic understanding of economics and economic phenomena to be explained especially in the context of the concept of scarcity and allocation of resources. Students may be introduced to the main points on which the various definitions of economics could be analyzed. Features of definitions and two- three criticisms.*
- (ii) Micro and Macro Economics – Meaning and Difference. Basic concepts: utility, price, value, wealth, welfare, money, market, capital, investment, income, production,

consumption, saving, Business cycle, Aggregate demand and Aggregate supply.

*Meaning and difference between Micro and Macro Economics. A conceptual understanding of the terms: Human wants-classification; factors of production; utility – types and features, total utility, marginal utility and diminishing marginal utility; price – definition and general rise and fall in price; value – real vs nominal value; wealth – explanation of the term, classification (personal and social); welfare – economic welfare, social welfare and relation between wealth and welfare; money – barter economy vs money economy; market – meaning and size; capital – meaning; investment – meaning, investment as a process of capital formation; income – meaning, factor incomes; production – meaning; consumption – meaning; saving – meaning; individual saving and aggregate savings.*

*The above terms to be explained with the help of relevant examples.*

- (iii) Basic problems of an economy: what to produce; how to produce; for whom to produce; efficient use of resources.

*The basic problem of scarcity and choice must be emphasized. As this problem is universal in character, i.e. faced by all economies, irrespective of the economic system they follow, it must be explained using the concept of Production Possibility Curve. The three problems - what to produce, how to produce and for whom to produce - must be*

*highlighted. The role of technology in shift and rotation in the Production Possibility Curve (assumptions and features) must be explained.*

- (iv) Types of economies: developed and developing; Economic systems: capitalism, socialism and mixed economy; mechanism used to solve the basic problems faced by each economy.

*Characteristics of developed and developing economies; India: introducing regional and global economic grouping such as SAARC, European Union, ASEAN, G-8, G-20 (basic knowledge) ; different types of economic systems; definition, features, merits and demerits of capitalism, socialism and mixed economic system; mechanisms used to solve the basic problems under each economic system to be explained with the help of examples. The role of government along with the price mechanism to be emphasized. Price mechanism as a tool to solve economic problem.*

## **2. Indian Economic Development**

- (i) Introduction.

*Indian economy post liberalization: Main features, problems and policies of agriculture, industry and foreign trade.*

- (ii) Parameters of Development.

*Parameters of development: per capita income (definition and limitations); meaning and construction of Human Development Index (HDI). India and HDI as per the UNDP report.*

- (iii) Planning and Economic Development in India.

*Planning and economic development in India: a brief explanation. Major objectives of all the Five-Year Plans. NITI Aayog: objectives and role.*

- (iv) Structural Changes in the Indian Economy after liberalization.

*Need, meaning, significance and features of liberalization, globalization and privatization of the Indian Economy; disinvestment: meaning.*

- (v) Current challenges facing the Indian Economy.

*Poverty – absolute and relative, vicious circle of poverty, main programmes for poverty alleviation: A critical assessment of PAPs (Poverty Alleviation Programmes); Rural development- Rural Credit (need, purpose and sources); Agricultural marketing: defects and government measures to improve agricultural marketing; role of cooperatives, agricultural diversification; alternate farming /organic farming: meaning and importance.*

*Human Capital formation: How people become resource; role of human capital in economic development; Growth of education sector in India; Education – formal and informal (Meaning only); Unemployment- types of unemployment, causes for unemployment, Policy measures (after 2000).*

- (vi) Economic Growth and Development.

*Economic Growth and Development – Meaning and difference.*

- (vii) Sustainable Development.

*Effect of Economic Development on Resources and Environment.*

*Understanding the concept of Sustainable development; Need for sustainable development for improving the quality of life - looking at the deteriorating quality of air, water, food over time, developing an appreciation to sustain at least what exists for the generations to come.*

*Global warming – meaning and effects.*

## **3. Statistics**

- (i) Statistics: definition, scope and limitations of statistics.

*Statistics: definition, scope and limitations of statistics. Special emphasis to be laid on importance of statistics in economics.*

- (ii) Collection, organization and presentation of data.

*Collection of data - Sources of data: primary, secondary. Methods of collecting data: Some important sources of collecting secondary data; ways of collecting primary data; organization of data: meaning and types of variables, frequency; presentation of data: tabular and diagrammatic presentation*

(bar diagram, pie, line, histogram, polygon and ogive curve).

- (iii) Measures of Central Value: average defined; type of averages: arithmetic mean; simple and weighted; median and mode; ungrouped and grouped data; numericals, relationship between mean, median and mode.

*Measures of Central Value: average defined; type of averages: arithmetic mean; simple and weighted; median and mode; ungrouped and grouped data. Numericals only on mean, median and mode for both ungrouped and grouped data. Relationship between mean, median and mode – the nature of the frequency distribution – symmetrical, positively skewed and negatively skewed.*

- (iv) Measures of dispersion: definition, methods of studying variation - range; standard deviation; quartile deviation; the mean or average deviation; coefficient of variation.

*Numericals on measures of dispersion required.*

- (v) Correlation: introduction, scatter diagram; Karl Pearson's coefficient of correlation; Spearman's coefficient of correlation.

*Meaning and significance of correlation to be explained along with types and degrees. Scatter diagram, Karl Pearson's method (two variables, ungrouped data); Spearman's Rank Correlation to be explained with the help of numericals.*

- (vi) Index numbers: simple and weighted - meaning, types and purpose. Problems involved in constructing a Price Index Number.

*What does an Index number show, measure or indicate (like a Price Index Number). Difference between simple and weighted – Price weighted or quantity weighted. Laspayre's, Paasche and Fisher's methods of index numbers (to be explained with the help of numericals). Wholesale Price Index, Consumer Price Index and Index of Industrial Production should be explained. Uses of Index Numbers. Problems involved in constructing Price Index Number – the choice of the base year, the number of commodities to be included (coverage), choice of prices and the method to be used.*

- (vii) Some Mathematical Tools used in Economics.

*Equation of a straight line and slope of a straight line.*

### PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

#### A list of suggested Projects is given below:

1. Study consumer awareness amongst households through designing a questionnaire and collection of primary data.
2. Prepare a report on productivity awareness among enterprises through use of statistical data from statistical tables published in Newspapers / RBI Bulletin / Budget / Census report / Economic survey, etc.
3. Make a study of two cooperative institutions (example milk cooperatives, etc.) with a view to compare the organizational and financial structure of the organizations, production capacity and output, marketing strategies, sales, market share, etc.
4. Study in detail the South Asian Association for Regional Cooperation (SAARC) and its impact on Indian economy
5. Prepare a report on the various poverty alleviation and employment generation programmes started in India, with special focus on MNREGA.
6. Compare the status of women of your State with that at the National level for the last ten years, on the basis of educational level, employment, etc.
7. Prepare a report on the forest cover in India, highlighting the following aspects:
  - (a) Five States/Union Territories having higher and lower forest cover and compare the extent of forest coverage.
  - (b) Causes for decrease in forest cover in the Country.
  - (c) Measures adopted by the Central/State Governments to increase the forest cover.

## CLASS XII

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II- Project Work** .....20 marks

### PAPER - I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions out of which candidates will be required to answer **five** questions, each carrying **12 marks**.

**Note:** The syllabus is intended to reflect a study of the theory of Economics with specific reference to the Indian Economy. Therefore, examples and specific references to the Indian Economy must be made wherever relevant.

### 1. Micro Economic Theory

- (i) Demand: meaning, factors affecting demand; Demand function; Law of Demand; derivation of demand curve; movement and shift of the demand curve; exceptions to the Law of Demand.

Law of Diminishing Marginal Utility, Law of Equimarginal Utility, consumer's equilibrium through utility approach (Cardinal) and indifference curve analysis (Ordinal).

*The concept of demand: meaning, types of demand. A demand function to be specified incorporating the determinants of demand. Diagrams should be used in explaining the Law of Demand, reasons for downward slope of demand curve, its derivation using demand schedule. Derivation of market demand curve from individual demand curve.*

*(a) Cardinal Utility Analysis: meaning of utility, total utility, marginal utility, relationship of TU and MU, Law of Diminishing Marginal Utility (schedule and diagram, Only assumptions to be taught, criticisms not required), Consumer's equilibrium – one commodity (schedule and diagram), Law of Equimarginal Utility (statement, schedule) and conditions of consumer's equilibrium using marginal utility; (b) Ordinal Utility Analysis: Indifference Curve – its meaning and properties (including MRS and DMRS),*

*indifference map, consumer's budget line, Consumer's equilibrium – condition (to be explained with the help of a diagram).*

- (ii) Elasticity of demand: meaning, types of elasticity of demand, measurement of elasticity of demand; factors affecting elasticity of demand.

*Various methods of measurement of the elasticity of demand: point method - percentage method, expenditure method and geometric method. (Numericals required on percentage method only). The cross and income elasticity of demand must be explained. Degrees of elasticity of demand to be explained. Use diagrams wherever necessary.*

- (iii) Supply: meaning; difference between stock and supply; determinants of supply; Law of Supply; movement and shift of the supply curve; elasticity of supply

*Difference between stock (intended supply) and supply (actual supply) with the help of relevant examples. A supply function should be specified and explained. Law of Supply: Meaning, supply schedule and supply curve. Derivation of market supply curve from individual supply curve. Movement and shift of the supply curve, exceptions to the Law of Supply. Elasticity of Supply: Meaning, degrees of elasticity of supply and measurement of elasticity of supply by percentage method and geometric method.*

- (iv) Market Mechanism: Equilibrium and disequilibrium; Equilibrium price and effect of changes in demand and supply on the equilibrium price. Simple applications of tools of demand and supply.

*A basic understanding of the concept of equilibrium. The effects of changes in demand and supply - both along the curves and shift of the curves to be explained. Basic understanding of Price control, rationing, Price ceiling and Floor price with the help of demand and supply curves.*

- (v) Concept of production and production function: (short run and long run production function), returns to a factor, returns to scale (meaning only) total, average and marginal physical products; Law of Variable Proportions and its three stages.

*A production function (concept only). Law of Variable Proportions: statement, assumptions, schedule (for the purpose of understanding and not for testing), diagram and explanation to the three stages.*

- (vi) Cost and revenue: Basic concepts of cost; fixed cost, variable cost, total cost, marginal cost and average cost – their relationships; opportunity cost; short run and long run cost curves. Revenue: meaning; average revenue, marginal revenue and total revenue and their relationships under perfect competition and imperfect competition, Producer's equilibrium.

*Basic concepts – private cost, economic cost, social cost, money cost, real cost, explicit cost, implicit cost.*

*Cost concepts – Fixed cost, variable cost, total cost, marginal cost, average cost with schedule and diagram; relationship between average cost, marginal cost, total cost (only concepts of long run and short run cost curves, derivations not required). Opportunity cost – meaning only. Difference between accounting cost and opportunity cost.*

*Revenue – Average revenue, marginal revenue, total revenue – concepts and relationships under perfect competition and imperfect competition. Producer's equilibrium (Profit maximization goal) – meaning; conditions: (a) TR and TC approach along with diagram (b) MR and MC approach along with diagram.*

- (vii) Main market forms: perfect competition, monopolistic competition, oligopoly, monopoly, monopsony; characteristics of the various market forms; equilibrium of a firm in perfect competition under short run and long run.

*Features of perfect competition, monopolistic competition, oligopoly, monopoly and monopsony (meaning only). Equilibrium of a firm in perfect competition under short run (explanation and diagram, shut down point and break-even point) and long run (diagram not required).*

## **2. Theory of Income and Employment**

Basic concepts and determination of Income and Employment

*The concept of demand (ex ante) and effective (ex post) demand. Aggregate demand and its components, propensity to consume and propensity to save (average and marginal), equilibrium output; investment multiplier (its meaning and mechanism with the help of a diagram). Simple numerical based on the above. Meaning of full employment. Problems of excess demand and deficient demand; measures to correct them.*

## **3. Money and Banking**

- (i) Money: meaning, functions of money, supply of money.

*Meaning, kinds of money, functions of money (primary, secondary and contingent) to be explained; supply of money (only meaning of  $M_0$ ,  $M_1$ ,  $M_2$ ,  $M_3$  &  $M_4$ ). Inflation: meaning, demand pull and cost push (diagrams not required)*

- (ii) Banks: functions of commercial bank; high powered money, credit creation by commercial banks; Central Bank: functions.

*Basic understanding of the functions of commercial banks, credit creation process with limitation. The regulatory role of the Central Bank, its functions and the way it controls the flow of credit needs to be explained. A brief mention may be made of quantitative CRR, SLR, Bank Rate policy (repo rate and reverse repo rate) and Open Market Operations) and qualitative methods.*

## **4. Balance of Payment and Exchange Rate**

Balance of Payment – meaning, components; foreign exchange – meaning, determination of exchange rate (Flexible).

*Balance of Payment - Meaning and components; Causes of disequilibrium and how the disequilibrium can be corrected; Foreign Exchange Rate – meaning, meaning of fixed and flexible exchange rate, determination of exchange rate in a free market. Concepts of depreciation, appreciation, devaluation and revaluation (meaning only).*

## **5. Public Finance**

- (i) Fiscal Policy: meaning and instruments of fiscal policy.

*Meaning and instruments of fiscal policy – Public Revenue: Meaning, taxes (Meaning and types), difference between direct and indirect taxes; Public Expenditure: Meaning*

and importance; Public Debt: Meaning and redemption; Deficit Financing: meaning.

- (ii) Government Budget: meaning, types and components.

*Meaning and types of Government budget – union, state; components – revenue and capital. Concept of deficit budget: revenue deficit, fiscal deficit, primary deficit – their meaning and implications.*

## 6. National Income

- (i) Circular flow of Income.

*A simple model explaining the circular flow of income with two, three and four sector models with leakages and injections.*

- (ii) Concepts and definition of NY, GNP, GDP, NNP, private income, personal income, personal disposable income, National Disposable Income and per capita income; relationship between the income concepts.

*A brief understanding of the mentioned national income aggregates is needed. The concepts of GNP and NNP should be explained both at factor cost and market prices, real GDP and nominal GDP, National Disposable Income (Gross and Net), GDP and Welfare, GDP as an indicator of Economic welfare.*

- (iii) Methods of measuring National Income: product or value-added method; income method and expenditure method with simple numericals based on them.

*Simple numericals based on all the methods to be covered for better understanding of the concept. Precautions and difficulties of measuring National Income for each method.*

## PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

**The project work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

## A list of suggested Projects is given below:

1. Study a Public Sector Enterprise with reference to its relevance to the Indian Economy and its future prospects. Analyse the trend of its growth for the last ten years.
2. Conduct a Socio-Economic survey of a locality (minimum sample size should be 30 households) with reference to:
  - (a) Demographic features.
  - (b) Consumption Pattern – Expenditure on necessities, comforts and luxuries.
  - (c) Occupational structure.
3. Compare the contribution made by different sectors of the economy towards GDP growth during the planning period.
4. Prepare a report on the competition in the Aviation Sector in India with reference to:
  - (a) Performance of the Public Sector and Private Sector.
  - (b) Operational strategies adopted by budget/low cost carriers.
5. Make a comparative analysis of lending performance of five Commercial Banks in the past six years with reference to the changing CRR and SLR.
6. Many thinkers believe that we are rapidly depleting our natural resources. Assume that there are only two inputs (labour and natural resources) producing two goods (wheat and gasoline) with no improvement in technology over time. Show what would happen to the Production Possibility Curve over time as natural resources are exhausted. How would invention and technological improvement modify your answer? On the basis of this example, explain why it is said “economic growth is a race between depletion and invention.”
7. Make a comparative study of the allocation of financial resources of the Central Government Budget on Agriculture, Defence, Industry and Education in the last ten years. Prepare a report on your observations.
8. Prepare a trend Analysis of Growth and Productivity of any *one* industry such as: Textile / Automobiles / Electronic and Tele-communication, etc. in India for the past ten years.

**NOTE:** No question paper for Project Work will be set by the Council.



### SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	<u>PROJECT 1</u>					<u>PROJECT 2</u>					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva- Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva- Voce by Visiting Examiner	Total Marks (H + I)	
		7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

<b>*Breakup of 7 Marks to be awarded separately by the Teacher and the Visiting Examiner is as follows:</b>		<b>Name of Teacher:</b> Signature: <span style="float: right;">Date</span>
<b>Overall Format</b>	1 Mark	<b>Name of Visiting Examiner</b> Signature: <span style="float: right;">Date</span>
<b>Content</b>	4 Marks	
<b>Findings</b>	2 Marks	

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner, and should be based on the Project only.**

# COMMERCE (857)

## Aims:

1. To develop an interest in the theory and practice of business, trade and industry.
2. To familiarise candidates with theoretical foundations, organising, managing and handling operations of a business firm.
3. To provide a study of the more important aspects of the commercial world.
4. To provide knowledge of the activities of commerce in the marketing of goods and services.

## CLASS XI

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II- Project Work** .....20 marks

### PAPER - I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary/ fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions out of which candidates will be required to answer **five** questions, each carrying **12 marks**.

#### 1. Nature and Purpose of Business

- (i) Classification of human activities - economic and non-economic.

*Classification of human activities - economic and non-economic. Types of economic activities.*

*Distinction between business, profession and employment.*

- (ii) Definition and concept of business; classification of business activities.

*Definition of business. Characteristics of business. Classification of business activities:*

- (a) *Industry: types of industries on the basis of activity (primary and secondary) and on the basis of size (micro, small, medium and large).*

*Role of small businesses in India.*

- (b) *Commerce: branches of Commerce.*

*Commerce - its nature and functions; importance of Commerce. Branches of Commerce - trade and aids to trade. Relationship between commerce, trade and industry.*

- (iii) Business objectives.

*Business objectives: economic; social; human and national. Role of Profit in business.*

#### 2. Forms of Business Organisations

- (i) Introduction to business organizations.

*Meaning, characteristics, types (private sector, public sector, Public Private Partnership (PPPs) /Joint Sector). Comparison between different types of organizations.*

- (ii) Sole trader - objectives; formation; merits and demerits.

*Meaning and definition of sole trader; characteristics and objectives of sole trader; merits and demerits.*

- (iii) Partnership

- (a) Meaning, features; types of partners and partnership firms.

*Meaning and definition of partnership; features of partnership firms; types of partners and partnerships.*

- (b) Registration of Partnership firms.

*Formation, meaning and contents of partnership deed; registration and consequences of non-registration.*

- (c) Evaluation of partnership; merits and demerits.

*Self-explanatory.*

- (d) Comparison of sole proprietorship and partnership.

*Self-explanatory.*

- (iv) Corporate Organisations.

- (a) *Joint Stock Company: meaning, features, merits, demerits and objectives.*

(b) *Stages of Formation of a Company.*

(c) *Promotion, meaning, role and types of promoters.*

(d) *Incorporation of a company -Meaning and steps of incorporation (including filing of documents), certificate of incorporation.*

(e) *Memorandum of Association and Articles of Association (excluding alterations) and distinction between the two documents.*

*Meaning and contents of MOA and AOA. Distinction between the MOA and AOA.*

(f) *Commencement of business.*

*Steps, Certificate of Commencement.*

(g) *Prospectus and statement in lieu of prospectus – meaning and contents only.*

(h) *Types of companies- Classification of companies on the basis of mode of incorporation, liability of members, public interest, ownership, control and nationality.*

*Public and private companies and their comparative studies, privileges of private companies.*

(i) *Global enterprises – Meaning, characteristics, merits and demerits of Global Enterprises.*

(v) *Public Sector Undertakings.*

(a) *Meaning; characteristics, objectives, role and forms of Public Sector Undertakings (Departmental Undertakings, Public Corporations and Government Companies).*

*Public Sector Undertakings – meaning; characteristics, objectives, role and criticisms. Forms of Public Sector Undertakings (Departmental undertakings; Public Corporations and Government companies – definitions, features, merits and demerits).*

(b) *Public Private Partnerships.*

*Meaning and features of PPPs.*

(vi) *Co-operative organisations - meaning; characteristics and types.*

*Co-operative organizations - meaning; characteristics, advantages and disadvantages; Types of cooperative organizations, distinction between joint stock companies and cooperative organizations.*

### **3. Social Responsibility of Business and Business Ethics**

Concept and need for social responsibility.

*Responsibility towards owners, investors, consumers, employees, government and community; Responsibility of business towards protection of environment; Meaning and importance of Business ethics.*

### **4. Emerging Modes of Business**

(i) *E-business.*

*Scope and benefits, Resources required for successful e-business implementation, online transactions, payment mechanisms, security and safety of business transactions.*

(ii) *Outsourcing.*

*Concept, need and scope of BPO and KPO.*

(iii) *Smart Cards.*

*Meaning and utility.*

### **5. Stock Exchange**

(i) *Meaning and importance.*

(ii) *Functions and services.*

(iii) *Major Stock Exchanges in India (BSE, NSE, DSE, ASE) – types and locations.*

(iv) *Types of operators – Brokers, Jobbers, Bulls and Bears.*

(v) *Terms used in Stock Exchange - ex-dividend, cum dividend, spot delivery, forward delivery.*

(vi) *SEBI – functions and objectives.*

*Self-explanatory*

### **6. Trade**

(i) *Wholesalers.*

*Meaning and services of wholesaler to retailer, customer and producer.*

(ii) (a) *Retail trade – Meaning and characteristics.*

*Retail trade - meaning, characteristics of retail trade. Distinction between wholesale and retail trade.*

- (b) Types of retail trade - Itinerant and small scale fixed shops: departmental store, chain store, mail order houses, tele shopping, franchise, consumer cooperative stores, hypermarkets and automatic vending machines.

*Meaning, features, merits and demerits to be covered.*

- (c) Documents used in home trade.

*Documents and procedure used in home trade – inquiry; quotation; catalogues; order; invoice; debit note; credit note.*

*Price quotations - cash discount and trade discount.*

- (iii) Role of Chambers of Commerce and Industry and Trade Associations.

*Meaning and functions of Chambers of Commerce and trade associations.*

## 7. Foreign Trade

- (i) Meaning, difference between internal trade and external trade.

*Meaning and characteristics of international trade; problems of international trade; advantages and disadvantages of international trade.*

- (ii) Export trade – Meaning, objectives and procedure of export trade.

*Self-explanatory.*

- (iii) Import trade – Meaning objectives purpose and procedure.

*Meaning and functions of import trade; objectives, purpose and procedure.*

- (iv) Documents involved in international trade.

*Documents involved in export trade, such as: indent, letter of credit, shipping order, shipping bill, mate's receipt, bill of lading, certificate of origin, consular invoice, documentary bill of exchange (DA/DP), all need to be explained.*

*Documents involved in import trade, such as: import license, indent, letter of credit, documentary bill of exchange, bill of entry, bill of sight, port trust dues receipt, application to import, advice note, bill of lading, all need to be explained.*

- (v) World Trade Organisation.

*WTO-meaning and objectives.*

## 8. Insurance

- (i) Insurance – Meaning, objectives and purpose.

*Meaning, objectives and purpose of insurance; Concept of re-insurance and double insurance.*

- (ii) Risks in business - insurable and non-insurable.

*Risks in business - insurable and non-insurable - meaning and examples of both. Characteristics of insurable risks.*

- (iii) Principles of insurance.

*Fundamental principles to be explained: utmost good faith; insurable interest; indemnity; contribution; doctrine of subrogation; causa proxima. mitigation of loss.*

- (iv) Types of insurance: life and non-life.

*Types of insurance – life, health, fire, marine, motor, social and fidelity insurance (Meaning and importance only).*

### PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

**A list of suggested Projects is given below:**

1. Select a daily use consumer product. Trace its origin right from the primary industry through the secondary and tertiary industries. Draw a flow chart to include all the business activities in its path from the producer to the consumer.
2. Assume you are starting a partnership firm with your friend/friends. Develop a business plan covering the following aspects:
  - Formation of this partnership firm – rules and steps that would be followed including the partnership deed
  - Choice of types of partners involved and your justification for the same.

3. Select two infrastructure projects of public sector undertakings that have been recently commissioned.

Analyze each project in terms of:

- Objectives
- Profitability
- Adherence to the time schedule for project completion.
- Social utility
- Conclusion.

4. Identify two Public Private Partnership projects.

Find out:

- The equity participation of both the partners.
- Objectives of the partnership
- Strengths both partners bring into the venture.

5. Select one consumer cooperative and one housing cooperative.

For each of the cooperatives:

- State the objectives.
- The organizational structure.
- Details of surplus distribution and the form of government support.

6. Study real time cases in which organizations did not show responsibility towards investors/ consumers/ employees/ government/ community. Take at least two such cases. For each case prepare a report based on the following:

- A brief about of the case.
- Different issues involved in the case.
- Who was at fault and why?
- What should the company have done to stand by the business ethics?
- Do you agree with the company's viewpoint? Give reasons.

7. Document and analyze the Corporate Social Responsibility activities of a pharmaceutical company and a five-star hotel.

Comment on the changing role assumed by Corporates towards business ethics and social responsibility in the last two decades.

8. Identify any trade association and chamber of commerce headquartered in your town/city. Study each in terms of:

- Its objectives.
- Services provided to members.
- Help given to the business community.

9. Contact an insurance agent and collect information about 5 different types of life insurance policies provided by different companies. Include information as per details given below for every insurance plan and make a comparative analysis.

- Premium of insurance
- Terms of inclusions and exclusions of each policy
- Term of the policy
- Withdrawal of money from the insurance scheme (surrender / foreclosure)
- Advantages/disadvantages of the plan

10. Study the BPO and KPO industry in India. Collect newspaper/magazine articles on BPOs and KPOs.

Prepare a report highlighting:

- Their contribution to the business community and the nation.
- Their growth over the past 10 years in India.

Comment on the social cost of such organisations.

11. Visit a company that is involved in e-business (which offers online services) or a consultancy, which helps in developing websites for such companies.

Study different aspects they keep in mind while preparing business plans for e-business. Include information regarding the payment mechanisms, security and safety of business transactions. The risks involved in e-business should also be covered. Also include the steps they follow while implementing the plan and starting the business.

## CLASS XII

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II- Project Work** .....20 marks

### PAPER - I (THEORY) – 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions out of which candidates will be required to answer **five** questions, each carrying 12 marks.

#### 1. Business Environment

Concept, and importance of Business Environment.

Meaning, features and importance of Business Environment;

Dimensions of Business Environment – Micro (Internal and External factors) and Macro (Economic, social, technological, political and legal) – meaning and components.

S.W.O.T. Analysis - A basic understanding of S.W.O.T. (Strength, Weakness, Opportunity and Threat) Analysis.

#### 2. Financing

(i) Capital: Sources of finance for sole trader; partnership; Joint Stock Company; financial planning.

Importance of finance for business. Sources of finance for different types of business firms. Meaning, features and importance of financial planning. Factors affecting capital structure. Fixed capital - meaning, factors affecting fixed capital. Working capital – meaning, types; factors affecting working capital. Comparison between fixed and working capital.

(ii) Sources of finance for a Joint Stock Company.

(a) Different types of shares: equity, preference.

Bonus shares, rights issue, ESOP, Sweat Equity Shares, Retained earnings.

Long-term sources of funds.

Equity shares - features, advantages and disadvantages.

Preference shares - features, types advantages and disadvantages; distinction between equity shares and preference shares.

Bonus and rights issue, ESOP and Sweat Equity Shares - meaning. Distinction between bonus shares and right shares.

Retained earnings – meaning, merits and demerits.

(b) Loan capital: debentures.

Debentures – meaning; kinds of debentures; advantages and disadvantages of debentures. Distinction between shares and debentures.

(c) Loans from commercial banks and Financial Institutions.

Loans from commercial banks and Financial Institutions - meaning, advantages and disadvantages.

(d) Short-term sources of funds.

Short-term sources of funds – different types of short-term financial assistance by Commercial Banks; public deposits, trade credit, customer advances, factoring, Inter corporate deposits and installment credit. Meaning, advantages and disadvantages of various sources of funds.

(iii) Banking - latest trends.

Online services- transfer of funds through Real Time Gross Settlement (RTGS), National Electronic Funds Transfer (NEFT), Immediate Payment Service (IMPS), issue of demand drafts online meaning and features.

*Online payments, e-Banking – meaning and features, advantages and disadvantages.*

*Mobile Banking - SMS alerts, transfer of funds, making payments - advantages and disadvantages.*

*Debit Cards vs Credit Cards, ATM (Automated Teller Machine) – Meaning; Debit card and credit card: features and differences.*

### **3. Management**

- (i) Management: Meaning, objectives and characteristics of management.

*Meaning of Management: as an activity; as a group; as a discipline; as a process. Objectives and characteristics of management.*

- (ii) Nature of Management – Science, Art and Profession.

*Self explanatory.*

- (iii) Importance of Management.

*Self explanatory.*

- (iv) Principles of Management: nature of principles; need for principles.

*Nature of principles of Management; need for principles of management; Taylor's 5 scientific principles of Management; Fayol's 14 principles of Management; Relevance of the principles of Management in today's business scenario. Comparison of Taylor's and Fayol's principles.*

- (v) Functions of Management: Planning; Organising; Staffing; Directing; Controlling and Coordinating.

- (a) Planning:

*Meaning, steps, importance & limitation; Types of plans; Objectives, policy, procedures, method, role, budget, program – meaning, features and differences.*

- (b) Organising:

*Meaning, importance, steps; Structure of organization (line, line and staff, functional and divisional; Formal and informal organization) – Meaning,*

*features, merits, demerits and differences between line and line & staff, functional and divisional, formal and informal; Meaning and importance of delegation of authority; Decentralization v/s Centralization, comparison between delegation and decentralization, merits and demerits.*

- (c) Staffing:

*Meaning, steps and importance; Recruitment – Meaning and sources; Selection – Meaning and procedure; Training and development – Meaning, types of training, difference between selection and recruitment, Training and Development.*

- (d) Directing:

*Meaning and importance; Supervision- Meaning, functions and span of control;*

*Motivation - Meaning and Maslow's theory; Leadership- Meaning and qualities of a good leader;*

*Communication - Meaning, objectives and process. Barriers to communication and overcoming barriers to communication.*

- (e) Controlling:

*Meaning, steps and importance; Relationship between Planning and Controlling; Management by Exception.*

- (f) Coordination:

*Meaning of Coordination; Coordination as an essence of Management.*

### **4. Marketing**

- (i) Marketing: concept and functions.

*Meaning and types of markets; meaning and features of marketing. Marketing concepts: traditional v/s modern - meaning and features of traditional and modern concepts of marketing. Comparison between marketing and selling. Objectives and importance of marketing; functions of marketing – meaning, features of each function of marketing.*

(ii) Marketing Mix - Meaning and Elements.

*Product Mix - goods and services - meaning, features and types of goods; meaning, features of services; difference between product and services. Branding: meaning and merits. Labeling: meaning and merits. Packaging: meaning and features of good packaging.*

*Price Mix – meaning, factors determining price.*

*Place Mix – meaning, channel of distribution choice of channels of distribution and physical distribution.*

*Promotion Mix – Meaning and elements.*

*Elements – Advertising, sales promotion, personal selling and publicity – meaning, features, objectives and differences.*

(iii) Consumer protection: rights of consumers, methods of consumer protection.

*Need for consumer protection; methods of consumer protection - self-help, legislative measures and consumer associations/NGOs, Consumer Protection Act, 2019 - Rights of consumers.*

*The Consumer Disputes Redressal Commissions (National, State and District).*

*Difference between Consumer Protection Act, 1986 and Consumer Protection Act, 2019.*

**PAPER II – PROJECT WORK – 20 Marks**

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

**The project work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

**A list of suggested Projects is given below:**

- Compare marketing strategies adopted by two different companies of the same industry (FMCG / Telecommunication / media / education industry etc.) keeping in mind the following:
  - Product mix
  - Price Mix
  - Place Mix
  - Promotion Mix
- Collect newspaper/magazine clippings of five cases filed by consumers in the Consumer Court. Find out the rights violated, and the redressal mechanism used. What was the outcome of each case?
- Visit a commercial Bank. Find out the procedure to open a savings account. Find out the details of various Agency & General utility services provided by the bank.
- Compare the interest rates offered by five different commercial banks on fixed deposits under various categories (general and senior citizens) and various time durations. Find out the procedure and formalities for opening a fixed deposit account. What is the procedure for closing the account on maturity and before maturity period?
- Select five different companies across varying industries such as I.T., textiles, FMCG, Health Care, etc., included in the SENSEX. Keeping a hypothetical base money of Rupees One Lakh, invest in the shares of the selected companies. The movement of share prices selected by you should be monitored over a period of one month on a daily basis. A uniform / standard practice of either using the opening price or the closing price on a particular day of the week should be used by all students in the class. At the end of the month, analyse your investment in a spread sheet and give reasons for your choice of scripts.



6. Find out the names of companies under various sectors (FMCG, Pharma, automobile, etc) included in the NIFTY and the SENSEX.

Make a chart of the same and track its movements over a period of one week.

7. (a) Study the sources of recruitment and steps involved in the selection procedure adopted by two companies of the same industry.
- (b) Compare and evaluate the sources of recruitment and the selection process adopted by the selected companies.
8. Formulate a capital plan for a hypothetical business organization.
- Justify your formulated plan.

9. Choose two companies of the same industry. Study their organizational structure. Also give information with regard to:

(i) Hierarchy

(ii) Centralization and delegation of authority

(iii) Flow of information (scalar chain)

(iv) Span of control

(v) Channel of communication.

10. Select any business undertaking. Study the selected business in terms of ownership, capital and profitability.

Make a S.W.O.T. analysis and present it in a tabular form.

**NOTE:** No question paper for Project Work will be set by the Council.

## SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	<u>PROJECT 1</u>					<u>PROJECT 2</u>					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)	(E + J)
		7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

<b>*Breakup of 7 Marks to be awarded separately by the Teacher and the Visiting Examiner is as follows:</b>		<b>Name of Teacher:</b>  <b>Signature:</b> _____ <b>Date</b> _____						
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%; padding: 5px;"><b>Overall Format</b></td> <td style="padding: 5px;"><b>1 Mark</b></td> </tr> <tr> <td style="padding: 5px;"><b>Content</b></td> <td style="padding: 5px;"><b>4 Marks</b></td> </tr> <tr> <td style="padding: 5px;"><b>Findings</b></td> <td style="padding: 5px;"><b>2 Marks</b></td> </tr> </table>	<b>Overall Format</b>	<b>1 Mark</b>	<b>Content</b>	<b>4 Marks</b>	<b>Findings</b>	<b>2 Marks</b>		<b>Name of Visiting Examiner</b>  <b>Signature:</b> _____ <b>Date</b> _____
<b>Overall Format</b>	<b>1 Mark</b>							
<b>Content</b>	<b>4 Marks</b>							
<b>Findings</b>	<b>2 Marks</b>							

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner, and should be based on the Project only.**

# ACCOUNTS (858)

## Aims:

1. To provide an understanding of the principles of accounts and practice in recording transactions and interpreting individual as well as company accounts.
2. To develop an understanding of the form and classification of financial statements as a means of communicating financial information.

## CLASS XI

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours ..... 80 marks

**Paper II- Project Work**.....20 marks

### PAPER - I (THEORY) – 80 Marks

There will be one paper of 3 hours duration of 80 marks divided into two parts:

**Part I (20 marks):** will be compulsory and will consist of short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

**Part II (60 marks):** Candidates will be required to answer **five** questions out of **eight** from this section. Each question shall carry **12 marks**.

#### 1. Introduction to Accounting

Background of accounting and accountancy; types of accounts; basic terms used in accounting, and Accounting Equation.

- (i) *Evolution of accounting: The three phases.*
- (ii) *Basic Terms: Event, Transaction, Vouchers, Capital, Assets (intangible, tangible, fixed, current, liquid, wasting and fictitious), Liabilities (internal and external – current, long-term and contingent), Trade Debtors, Trade Creditors, Purchases, Sales, Goods traded in, Stock (raw material, work in progress and finished goods), Profit, Loss, Expense, Revenue, Income and Drawings.*
- (iii) *Accounting equation: Meaning and usefulness.*
- (iv) *Meaning and definition of Book-keeping, Accounting and Accountancy; difference between book-keeping, accounting and accountancy; accounting cycle.*
- (v) *Users of accounting information.*

(vi) *Subfields of accounting: Meaning of financial accounting, cost accounting and management accounting.*

**NOTE:** Practical problems in Accounting Equation are not required.

#### 2. Journal, Ledger and Trial Balance

- (i) Journal: recording of entries in journal with narration.
  - (a) *Classification of Accounts- traditional classification or modern approach.*
  - (b) *Double Entry System.*
  - (c) *Rules of journalizing – traditional classification or modern approach.*
  - (d) *Meaning of journal; Advantages of using a journal.*
  - (e) *Format of journal.*
  - (f) *Simple and compound journal entries.*
  - (g) *Opening Journal entry.*
  - (h) *Journal Entries- Input CGST and Input SGST / Input IGST; Output CGST and Output SGST/ Output IGST) / Setting off Input GST against Output GST.*
- (ii) Ledger: posting from journal to respective ledgers.
  - (a) *Meaning of ledger.*
  - (b) *Format of a ledger.*
  - (c) *Mechanics of posting.*
  - (d) *Closing / Balancing of ledger accounts- expenses and revenues to be closed by transferring to Trading / P/L Account depending upon their direct/ indirect nature and balances of Assets, Liabilities and Capital to be carried down.*
  - (e) *Adjusting and closing journal entries.*

(iii) Sub-division of journal - cash book [including simple cash book and triple column cash book (cash, bank and discount) with - contra entry pertaining to receipt of cheque not deposited on the same day; adjustments pertaining to a definite cash balance to be maintained / overdraft facility to be availed at the end of the month. Petty cash book (including analytical and imprest system), sales day book, purchases day book, sales return day book, purchases return day book and Journal proper.

(a) *Cash book [including simple cash book and triple column cash book (cash, bank and discount) with - contra entry pertaining to receipt of cheque not deposited on the same day; adjustments pertaining to a definite cash balance to be maintained / overdraft facility to be availed at the end of the period].*

(b) *Petty cash book (including analytical and imprest system).*

(c) *Sales day book, purchases day book- Simple (Date, Particulars, I. No, L.F, Details, Amount); Columnar (Date, Particulars, I. No, L.F, Details, Net Invoice, Goods, Carriage, GST-Input CGST and Input SGST / Input IGST; Output CGST and Output SGST / Output IGST- Amount or percentage given).*

(d) *Sales return day book, purchases return day book- Simple (Date, Particulars, Credit/ Debit Note No., L.F, Details, Amount.*

(e) *Journal proper.*

(f) *Mechanics of posting from special subsidiary books.*

**NOTE:** *Transactions with GST is excluded in Cash Book and Returns Books.*

(iv) Trial Balance.

(a) *Meaning, objectives, advantages and limitations of a Trial Balance.*

(b) *Preparation of the Trial Balance by the balance method from the given ledger account balances.*

### 3. Bank Reconciliation Statement

Bank Reconciliation statement.

(i) *Meaning and need for bank reconciliation statement.*

(ii) *Preparation of a bank reconciliation statement from the given cash book balance / overdraft or pass book balance / overdraft.*

(iii) *Preparation of a bank reconciliation statement from the extract of the cash book as well as the pass book relating to the same month. (Practical problem not required)*

(iv) *Preparation of an amended cash book and a bank reconciliation statement after adjusting the cash book balance from the given cash book balance.*

### 4. Depreciation

Depreciation, Methods of charging depreciation, Method of recording depreciation.

(i) *Depreciation: meaning, need, causes, objectives and characteristics.*

(ii) *Methods of charging depreciation: Straight Line and Written Down Value method; advantages, limitations of both the methods and differences between the two.*

(iii) *Methods of recording depreciation: charging to asset account, creating provision for depreciation / accumulated depreciation.*

(iv) *Problems relating to purchase and sale of assets (with or without asset disposal account) incorporating the application of depreciation under the two stated methods.*

**NOTE:** *Questions on change of method from SLM to WDV and vice-versa are not required.*

### 5. Bills of Exchange

(i) Introduction to Negotiable Instruments: explanation of basic terms.

*Meaning of negotiable instruments; Bills of exchange, promissory note (including specimen and distinction), cheque, advantages and disadvantages of Bills of Exchange, explanation of basic terms - drawer, drawee, payee, endorser, endorsee, bill on demand / bill on sight, bill after date, bill after sight, tenure of the bill, days of grace, due date, endorsement and discounting of bills, bill sent for collection, dishonour of a bill, holder of a bill, noting charges, notary public, renewal of a bill, retirement of a bill and insolvency of the drawee/acceptor.*

- (ii) Practical problems on the above in the books of drawer, drawee and endorsee- Journal entries and Ledger accounts.

*Self explanatory.*

**NOTE:**

- *Accommodation Bill is not required.*
- *Recording in the books of the bank not required.*

**6. Accounting Concepts**

GAAP (Generally Accepted Accounting Principles), Basis of Accounting; Accounting Standards; Knowledge and understanding of IFRS (International Financial Reporting Standards).

- (i) *GAAP: Going Concern, Accounting Entity, Money Measurement, Accounting Period, Complete Disclosure, Revenue Recognition, Verifiable Objective, Matching Principle, Historical Cost, Accrual Concept, Dual Aspect Concept, Materiality, Consistency, Prudence and Timeliness, Industry Practice, Substance over legal form.*
- (ii) *Basis of accounting – cash basis and accrual basis (meaning; difference).*
- (iii) *Accounting Standards: Meaning; Utility/ Advantages.*
- (iv) *IFRS (International Financial Reporting Standards) - Meaning; Need for IFRS; Fundamental Assumptions in IFRS- Going Concern, Accrual, Measuring Unit, Purchasing Power; difference between IFRS and Indian GAAP; Procedure for implementation of IFRS; India and IFRS.*

**7. Final Accounts and Concept of Trading, Profit and Loss account and Balance Sheet (with and without adjustments), Marshalling of Balance Sheet**

- (i) Capital and Revenue Expenditure/Income.
- (a) *Meaning and difference between capital expenditure and revenue expenditure with examples.*
- (b) *Meaning and difference between capital income and revenue income with examples.*
- (c) *Meaning and difference between capital profit and revenue profit with examples.*
- (d) *Meaning and difference between capital loss and revenue loss with examples.*
- (e) *Meaning of deferred revenue expenditure with examples.*

- (ii) Provisions and Reserves.

*Meaning, importance; difference between provisions and reserves; types of reserves - revenue reserve, capital reserve, general reserve, specific reserve and secret reserve.*

- (iii) Trading, Profit and Loss Account and Balance Sheet of a sole trader, (Horizontal Format) without adjustments.

*Meaning, objectives, importance and preparation of Trading, Profit and Loss Account and Balance Sheet of a sole trader.*

- (iv) Preparation of Trading Account, Profit and Loss Account and Balance Sheet with necessary adjustments.

*Adjustments relating to closing stock, outstanding expenses, prepaid expenses, accrued income, income received in advance, depreciation, bad debts, provision for doubtful debts, provision for discount on debtors, manager's commission (on the net profit before and after charging such commission), goods distributed as free samples, goods taken by the owner for personal use and abnormal loss; Treatment of Adjusted Purchases and calculation of cost of goods sold.; Input CGST and Input SGST/ Input IGST and Output CGST and Output SGST/ Output IGST given in the Trial Balance to offset against each other in the Balance Sheet.*

- (v) Marshalling of a Balance Sheet: Order of permanence and order of liquidity.

- (vi) Adjusting, closing and transfer entries.

*GST is excluded in Adjustments.*

**NOTE:**

1. *Practical problems on preparation of provision for doubtful debts account are not required.*
2. *Since creating provision for doubtful debts accounts involves being prudent, in the absence of any information of the amount of the new provision, it will be assumed that the amount of the new provision will be the same as the old provision unless the remaining debtors are good.*

## 8. Rectification of Errors

Errors and types of errors: Rectification of errors after the preparation of trial balance and rectification of errors after the preparation of Final Accounts.

- (i) *Types of Errors: errors of omission, errors of commission, errors of principle, compensating errors.*
- (ii) *Rectification of errors after the preparation of trial balance and through suspense account if required.*
- (iii) *Rectification of errors after the preparation of Final Accounts through P/L Adjustment A/c if required.*

**NOTE:** *Redrafting of Balance Sheet not required.*

## 9. Accounts from incomplete records

- (i) Single entry and difference with double entry.
  - (a) *Meaning, characteristics and limitations.*
  - (b) *Difference between Statement of Affairs and Balance Sheet.*
- (ii) Ascertainment of profit/loss by statement of affairs method including application.  
*Self-explanatory.*

**NOTE:** *Single entry system as applied to partnership firms is not required.*

*Conversion of Single Entry into Double Entry not required.*

## 10. Non -Trading Organisation

- (i) Non-Trading Organization: meaning, objectives, necessity and treatment of specific items.  
*Self-explanatory.*
- (ii) Different books maintained and differences between them.
  - (a) *Receipts and Payments Accounts: meaning, features, differences between Receipts and Payments Account and Cash Book.*
  - (b) *Income and Expenditure Accounts: meaning, features, difference between Income and Expenditure account and Profit and Loss account.*
  - (c) *Balance Sheet and its role.*

- (iii) Preparation of Income and Expenditure Account and Closing Balance Sheet.

*Preparation of Income and Expenditure Account and Balance Sheet when Receipts and Payments Account and other information is given.*

- (a) *Entrance, admission fees, life membership fees, legacies, special grants and special donations are to be capitalised.*
- (b) *General donations, general grants and all receipts of a recurring nature such as membership fees/ subscriptions are to be taken as revenue receipts.*
- (c) *Preparation of accounts of incidental activities such as restaurant accounts are not required.*

**NOTE:** *Preparation of a Receipt and Payments Account only or an Income and Expenditure Account with a Balance Sheet from incomplete records need not be covered (in horizontal format).*

## 11. Introduction to the use of Computers in Accounting

**Introduction to Computerised Accounting System:** Components of CAS, Features, Advantages and Limitations of CAS, Accounting Information System and Management Information System.

- (i) *Components of Computerised Accounting System (CAS)-hardware and software; operation of the computer system- input, processing, auxillary storage, output, application of computer in accounting.*
- (ii) *Comparison of accounting processes in manual and computerized accounting.*
- (iii) *Advantages and limitations of CAS.*
- (iv) *Types of Accounting Packages or software- ready to use, customized, tailor-made with their advantages and limitations.*
- (v) *Accounting Information System and Management Information System-Meaning.*

## PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project only	3 marks

### A list of suggested Projects is given below:

1. Preparation of Journal / sub-division of journal, Ledger, Trial balance and Financial Statements of a trading organization on the basis of a case study.

- Develop a case study of a sole trader starting business with a certain amount of capital.

He could have got the amount from his past savings or by borrowing from a bank by mortgaging his personal assets or by winning a lottery or any other source.

- Write in detail, his transactions during the year- his purchases - cash and credit, sales-cash and credit, expenses, purchase of fixed assets and depreciation charged on them, any outstanding expenses, prepaid expenses, accrued income, drawing bills of exchange, accepting bills payable, etc.
- From this case study developed (which should have at least 15 transactions), pass the journal entries, post them into the ledger, prepare a Trial Balance and the Trading and Profit and Loss Account and Balance Sheet.
- The various expenses for comparison purposes, could be depicted in the form of bar diagrams and pie charts.

2. Preparation of the accounts of a Not-for-Profit-Organisation on the basis of a case study.

- Develop a case study of an NPO by beginning with the primary motive of establishing it, that is, why have you decided to open a club or a library or a hospital, etc.
- Write in detail about the sources of capital fund, subscriptions, donations (ordinary and special), other receipts and payments of your NPO as well as outstanding expenses, prepaid expenses, subscription due but not received, subscription received in advance, purchase of

fixed assets and depreciation charged on them, legacy received, etc.

- From this case study developed (which should have at least 15 transactions), pass the journal entries, post them into the ledger, prepare a trial balance and thereafter prepare the NPO's Cash Book, Receipts and Payment Account, its Income and Expenditure Account and its Balance Sheet.
- The various expenses, for comparison purposes, could be depicted in the form of bar diagrams and pie charts.

3. Prepare a Bank Reconciliation Statement and Amended Cash Book from the information given in your Cash Book and Bank Statement (Pass Book) with at least fifteen transactions.

4. Complete the labels.

- (i) Prepare a Spreadsheet as per the following format:

Revenue	Jan.	Feb.	March	April
Outdoor Sales				
Indoor Sales				
Total Sales				
Expenses				
Salaries				
Rent & Utilities				
Others				

- (ii) Fill the Sales and Expenses for the months in lakhs and calculate the Total Sales and Total Expenses.

- (iii) Calculate the Net Profit using the excel formulas by subtracting the expenses from revenue.

- (iv) Highlight all the numbers and prepare a Bar Chart showing the Indoor and Outdoor Sales for the months.

- (v) Save your work on the desktop as **Label\_Project**.

- (vi) Print a hard copy of your work and close the file.

## CLASS XII

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II-** Project Work .....20 marks

### PAPER - I (THEORY) – 80 Marks

There will be one paper of 3 hours duration of 80 marks divided into three Sections A, B and C.

It will be **compulsory** for all candidates to attempt **Section A**.

**Section A (60 Marks):** will consist of **two** parts, **Part I** and **Part II** and have a total of **eight** questions.

**Part I (12 Marks):** will consist of **Question 1 (compulsory)**. This question will include short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects. **Question 1** will be based on **Section A** of the syllabus.

**Part II (48 Marks):** Candidates will be required to answer **four** questions out of **seven** from this part. Each question shall carry **12 marks**. Part II will also be based on **Section A** of the syllabus.

**Section B/C (20 marks):** Candidates will have a choice of attempting questions **either** from **Section B** or **Section C**. Candidates will be required to answer **two** questions out of **three** from the section of their choice. Each question shall carry **10 marks**.

### SECTION A

#### 1. Partnership Accounts

##### A. Fundamentals of Partnership

- (i) Definition, meaning and features of a Partnership.

*Self-explanatory.*

- (ii) Provisions of The Indian Partnership Act, 1932, with respect to books of accounts.

(i) *Meaning and importance.*

(ii) *Rules applicable in the absence of a partnership deed.*

- (iii) Preparation of Profit and Loss Appropriation Account and Partners' Capital and Current Accounts.

(a) *Profit and Loss Appropriation Account.*

(b) *Partners' capital accounts: fixed and fluctuating.*

(c) *Partners' Current Accounts when fixed capital method is followed*

*Interest on capital, interest on drawings, interest on current accounts (debit and credit) salary, commission to partners and managers, transfer to reserves, division of profit among partners,*

(d) *Guarantee of profits*

(e) *Past adjustments (Relating to interest on capital, interest on drawing, salary and profit-sharing ratio).*

#### NOTE:

- *Interest on loan given by the partner to the firm is to be taken as a charge against profits. This interest will be debited to the P/L account and credited to his loan account.*
- *Interest on loan taken by a partner from the firm should be credited to P/L account and debited to his capital/current account as the case may be.*
- *Rent due to a partner is a charge against profit and is to be credited to partners' current account in case of fixed capital system or to partners' capital account when capitals are fluctuating.*
- *Rectification of errors (past adjustments) through a single journal entry/ adjusting and closing journal entries, preparation of partners' adjusted capital/current accounts.*
- *Admission of manager as a Partner is excluded from the topic of past adjustments/guarantee of profits.*



## B. Goodwill

Concept of goodwill and mode of valuation.

- (a) *Meaning, nature and features of Goodwill.*
- (b) *Factors affecting the value of goodwill.*
- (c) *Mode of Valuation.*
  - *Average profit method – Meaning and practical application.*
    - *Simple average.*
    - *Weighted average method.*
  - *Super profit method – Meaning and practical application.*
  - *Capitalization method – Meaning and practical application.*
    - *Capitalization of average profit.*
    - *Capitalization of super profit.*

**NOTE:** *Capital Employed/Net assets are Total assets (excluding purchased goodwill, non-trade investments and fictitious assets) less outside liabilities.*

*Investments to be taken as non-trade investments unless specified as trade investments.*

## C. Reconstitution of Partnership

### I. Admission

- (i) Calculation of new profit-sharing ratio, sacrificing ratio and gaining ratio.

*Self-Explanatory*
- (ii) Accounting treatment of goodwill on admission of a partner.

*Based on Accounting Standard -26 issued by the Institute of Chartered Accountants of India in the context of Intangible Assets.*

  - (a) *Premium for goodwill paid privately.*
  - (b) *Premium for goodwill paid (in cash or kind) and retained in the business.*
  - (c) *Premium for goodwill paid and withdrawn by the old partners.*

- (d) *When the incoming partner cannot bring premium for goodwill in cash, adjustments are to be done through his current account.*
- (e) *Hidden goodwill.*
- (f) *When goodwill appears in the old Balance Sheet.*

### (iii) Preparation of Revaluation Account.

*Preparation of a Revaluation Account where changes in the values of assets and liabilities are reflected in the new Balance Sheet after reconstitution of a partnership firm.*

### (iv) Accounting treatment of accumulated profits and losses.

*General Reserve / Reserve Fund, Workmen Compensation Reserve/ Fund, Investment Fluctuation Reserve/Fund, Contingency Reserve, Profit and Loss Account (Debit and Credit balance) and Advertisement Suspense Account/ Deferred Revenue Expenditure.*

### (v) Adjustment of Capitals.

- (a) *Adjustment of old partner's Capital Accounts on the basis of the new partner's capital.*
- (b) *Calculation of new partner's capital on the basis of old partner's adjusted capital.*

### (vi) Change in Profit-Sharing Ratio.

*Change in PSR takes place at the time of admission of a partnership firm.*

*Accounting treatment of accumulated profits and losses through one journal entry: (Adjustment of the incoming partner's share to be done through his current account-similar to the treatment of goodwill not brought in cash.)*

*Gaining Partners' Cap/Current A/c Dr.  
To Sacrificing Partners Cap/Current (in case of profits).*

*Sacrificing Partners' Cap/Current A/c Dr.  
To Gaining Partners Cap/Current (in case  
of losses)*

*General Reserve/ Reserve fund, Workmen  
Compensation Reserve/ Fund, Investment  
Fluctuation Reserve/ Fund, Contingency  
Reserve, Profit and Loss Account (Debit  
and Credit Balance) and Advertisement  
Suspense Account/ Deferred Revenue  
Expenditure.*

**NOTE:**

- *Preparation of Balance Sheet during admission of a partner to be done in Horizontal format.*
- *Memorandum revaluation account, Joint Life Policy, Individual life policy are excluded from the syllabus.*
- *Admission of a partner during an accounting year is excluded from the syllabus.*

**II. Retirement and death of a partner**

(i) Calculation of new profit-sharing ratio, gaining ratio and sacrificing ratio.

*Self-Explanatory.*

(ii) Adjustment with regard to goodwill including hidden goodwill.

*Self-Explanatory.*

(iii) Adjustment with regard to undistributed profits and losses.

*Self-Explanatory.*

(iv) Adjustment with regard to share of profits of the retiring or deceased partner from the date of the last Balance Sheet to the date of retirement or death (on the basis of time or turnover).

*Through P & L Suspense A/c (in case of no change in PSR of remaining partners).*

*Through Gaining Partners capital/ current A/c (in case of change in PSR of remaining partners).*

(v) Preparation of Revaluation Account on retirement or death of a partner.

*Self-Explanatory.*

(vi) Adjustment of capitals.

(a) *Readjusting the adjusted capital of the continuing partners in the new profit-sharing ratio.*

(b) *Adjusting the capitals of the continuing partners on the basis of the total capital of the new firm.*

(c) *When the continuing partners bring in cash to pay off the retiring partners.*

(vii) Calculation and payment of amount due to retiring partner.

*Self-Explanatory.*

(viii) Preparation of retiring partner's loan accounts and deceased partner's executor's loan account (with interest on loan accrued and due and interest on loan accrued but not due).

*Self-explanatory.*

(ix) Change in Profit-Sharing Ratio.

*Change in PSR takes place at the time of retirement / death of a partnership firm.*

*Accounting treatment of accumulated profits and losses through one journal entry:*

*Gaining Partners' Cap Current A/c Dr.*

*To Sacrificing Partners' Cap/Current (in case of profits).*

*Sacrificing Partners' Cap/Current A/c Dr.*

*To Gaining Partners' Cap/Current (in case of losses)*

*General Reserve/ Reserve fund, Workmen Compensation Reserve/ Fund, Investment Fluctuation Reserve/ Fund, Contingency Reserve, Profit and Loss Account (Debit and Credit Balance) and Advertisement Suspense Account/ Deferred Revenue Expenditure.*

**NOTE:**

- Preparation of Balance Sheet during retirement / death of a partner to be done in Horizontal format only.
- Memorandum Revaluation Account, Joint Life Policy, Individual life policy are excluded from the syllabus.

**III. Dissolution of a Partnership firm.**

- (i) Meaning of dissolution and settlement of accounts under Section 48 of The Indian Partnership Act 1932.

*Self- Explanatory*

- (ii) Preparation of Memorandum Balance Sheet, Realization Account, Partner's Loan Account, Partner's Capital Account and Cash/Bank Account.

*Self-explanatory.*

**NOTE:**

*When an asset or a liability is taken to the realization account any corresponding/related fund or reserve is also transferred to realization account and not to the partners' capital accounts.*

*When accounts are prepared on a fixed capital basis, partners' current account balances are to be transferred to capital account. No adjustments are required to be passed through current account.*

*Bank overdraft is to be taken to the Bank/Cash A/c and not to be transferred to realization account but bank loan must be transferred to realization account.*

- *If question is silent about the payment of a liability, then it has to be paid out in full.*
- *If the question is silent about the realization of an asset, its value is assumed to be nil.*
- *Loan taken from a partner will be passed through cash or bank account even if the partner's capital account has a debit balance.*
- *Loan given to a partner will be transferred (debited) to his Capital account.*
- *Admission cum retirement, amalgamation of firms and conversion/sale to a company together with piecemeal distribution and insolvency of a partner / partners not required.*

**2. Joint Stock Company Accounts**

**A. Issue of Shares**

Problems on issue of shares.

- (a) Issue of shares at par and premium under Companies Act, 2013.
- (b) Issue of shares for considerations other than cash:
  - To promoters (can be considered either through Goodwill account or Incorporation costs account).
  - To underwriters.
  - To vendors.
- (c) Calls in arrears, calls in advance and interest thereon..
- (d) Over and undersubscription (including pro-rata allotment).
- (e) Preparation of Journal; Cash Book and Journal Proper; Ledger Accounts.

**NOTE:** *In pro-rata allotment when shares are issued at a premium, excess money received on application will first be adjusted towards the share capital. Any excess thereon will be utilized towards the Securities Premium Reserve.*

*When allotment or any call money is due, it is to be transferred to the calls in arrears account, on which interest, if provided in the Articles of Association, will be calculated.*

- (f) Forfeiture and reissue of shares at par, premium or discount.  
*Self-explanatory.*
- (g) Disclosure of Share capital in the company's Balance Sheet.

**NOTE:** *Issue of bonus and rights shares, private placement of shares, sweat equity shares, employees' stock option scheme, reservations for small individual participants and minimum tradable lots are not required.*

**B. Issue of Debentures**

Problems on issue of debentures (at par, at premium and at discount.)

*Problems on issue of debentures to include:*

- (a) *Issue of debentures at par, at premium and at discount under Companies Act 2013.*
- (b) *Issue of debentures as collateral security for a loan.*

- (c) *Issue of debentures for considerations other than cash.*
- *To promoters.*
  - *To underwriters.*
  - *To vendors*
- (d) *Accounting entries at the time of issue when debentures are redeemable at par and premium.*
- (e) *Calls in arrears, calls in advance and interest thereon.*
- (f) *Interest on debentures (with TDS).*
- (g) *Disclosure of Debentures in the company's Balance Sheet.*
- (h) *Methods of writing off discount / loss on issue of debentures- when debentures are redeemable in a lump sum at the end of a specified period; when debentures are redeemable in instalments.*
- (i) *Disclosure of discount on issue of debentures in the company's Balance Sheet when debentures are redeemed in instalments.*

### **C. Redemption of Debentures**

- Creation of Debenture Redemption Reserve (wherever applicable)
- Redemption of debentures out of profits.
- Redemption of debentures out of capital.
- Redemption of debentures in a lump sum.
- Redemption of debentures in annual instalments by draw of lots.
- Redemption of debentures by purchase in the open market- for immediate cancellation; as an investment and then later cancelled.

*Self-Explanatory.*

#### **NOTE:**

- I.** Calculation of ex-interest and cum-interest are not required.
- II.** In case of redemption of debentures in annual instalments by draw of lots:
  - (i) The entire DRI purchased for the redemption of the instalment of

debentures is not sold at the end of the year but sold/further purchased to the extent to maintain 15% of the face value of the debentures to be redeemed in the next instalment. In case of redemption in equal instalments, DRI purchased for the first instalment remains invested till the last instalment.

- (ii) Wherever applicable, DRR is transferred to General Reserve in proportion to the debentures redeemed.

### **III. Rules relating to creation of**

Debenture Redemption Reserve (DRR):

- (i) Listed companies including NBFCs registered with RBI and HFCs registered with National Housing Bank (NHB) both for public issue as well as private placements do not require the creation of a DRR of 25 per cent of the value of outstanding non-convertible debentures.
- (ii) Unlisted NBFCs registered with RBI and HFCs registered with National Housing Bank (NHB) both for public issue as well as private placements do not require the creation of a DRR of 25 per cent of the value of outstanding non-convertible debentures.
- (iii) For unlisted companies (other than NBFCs and HFCs), DRR is reduced from the present level of 25 per cent to 10 per cent of the outstanding debentures.

Rules regarding Debenture Redemption Investment (DRI)

- Unlisted NBFCs and HFCs need not deposit any amount of its debentures maturing during the year with scheduled banks or invest it in specified government securities.
- The following companies will continue to invest or deposit, on or before 30<sup>th</sup> April in each year, a sum which shall not be less than 15 per cent, of the amount of its debentures maturing during the year, ending on 31<sup>st</sup> March of the next year, in deposits with any scheduled bank, free from any charge or lien / in unencumbered securities of the Central Government or any State

Government / in unencumbered securities mentioned in Section 20 of the Indian Trusts Act, 1882/ in unencumbered bonds issued by any other company notified under Section 20 of the Indian Trusts Act, 1882:

- (i) Listed companies including NBFCs registered with RBI HFCs National Housing Bank (NHB) and unlisted companies (other than NBFCs and HFCs).
- (ii) Unlisted companies (other than NBFCs and HFCs).

*Basically, All India Financial Institutions regulated by RBI, Banking Companies for both public as well as privately placed debentures, other Financial Institutions within the meaning of Section 2(72) of the Companies Act, 2013 and unlisted NBFCs registered with RBI and HFCs registered with National Housing Bank (NHB) are exempted both, from creating DRR and from making a DRI.*

**D. Final Accounts of Companies**

Preparation of the Balance Sheet of a company (along with notes to accounts) as per Schedule III Part I of Companies Act 2013.

*As per the amendment made in Accounting Standard 4, dividend proposed for a year is not a liability till it has been approved by the shareholders. Thus, proposed dividend is not shown as a short-term provision in the current Balance Sheet of a company but disclosed in Notes to Accounts under Contingent Liabilities.*

*All capital losses to be written off in the year in which they occur unless otherwise mentioned.*

**NOTE: Schedule III Part II of Companies Act 2013 (Statement of Profit and Loss) is not required for the purpose of preparing final accounts of a Company.**

**However, for the preparation of Comparative and Common Size Income Statements (Section B – Unit 4: Financial Statement Analysis), the extent and format of the Statement of Profit and Loss as per Schedule III Part II of the Companies Act 2013 to be studied is as follows:**

*Statement of Profit and Loss for the year ended:.....*

	<i>Particulars</i>	<i>Note No.</i>	<i>Figures for the Current reporting period</i>	<i>Figures for the Previous reporting period</i>
<i>I</i>	<i>Revenue from operations</i>			
<i>II</i>	<i>Other Income</i>			
<i>III</i>	<i>Total Revenue (I + II)</i>			
<i>IV</i>	<i>Expenses:</i> <i>Cost of materials consumed</i> <i>Purchases of Stock-in-Trade</i> <i>Changes in inventories of finished goods</i> <i>Work-in-progress and Stock-in Trade</i> <i>Employee benefits expense</i> <i>Finance costs</i> <i>Depreciation and amortization expense</i> <i>Other expenses</i> <i>Total expense</i>			
<i>V</i>	<i>Profit before tax (III-IV)</i>			
<i>VI</i>	<i>Less Tax</i>			
<i>VII</i>	<i>Profit after Tax (V-VI)</i>			

## SECTION B

### MANAGEMENT ACCOUNTING

#### 3. Financial Statement Analysis

Comparative Statements and Common Size Statements.

*Meaning, significance and limitations of Comparative Statements and Common Size Statements.*

*Preparation of Comparative Balance Sheet and Statement of Profit and Loss (inter-firm and intra-firm) showing absolute change and percentage change.*

*Common size Balance Sheet to be prepared as a percentage of total assets and total liabilities.*

*Common size Statement of Profit and Loss to be prepared as a percentage of Revenue from operations.*

**NOTE:** Preparation of comparative statements and common size statements to be made from the Balance Sheets and Statements of P/L without notes to accounts.

#### 4. Cash Flow Statement (Only for Manufacturing Companies)

(i) Meaning, importance and preparation of a Cash Flow Statement.

***NOTE:** Based on Accounting Standard – 3 (revised) issued by the Institute of Chartered Accountants of India.*

(ii) Calculation of net cash flows from operating activities based on Indirect Method only.

*Preparation of a Cash Flow Statement from two consecutive years' Balance Sheet with or without adjustments.*

*Preparation of complete/partial cash flow statement from extracts of Balance Sheets and Statements of P/L with or without adjustments.*

**NOTE:** Any adjustment or an item in the Balance Sheet relating to issue of bonus shares, extraordinary items and refund of tax are not required.

(iii) Preparation of Cash Flow Statement on basis of operating, investing and financing activities.

*The following items are to be taken when calculating net cash flows from financing activities:*

- *Issue of shares at par and premium, issue of debentures at par, premium and discount.*
- *Redemption of preference shares and debentures at par.*
- *Interest paid on Long-Term and Short-Term Borrowings.*
- *Dividend– interim and final- paid on shares.*
- *Long-term borrowings and Short-term borrowings – bank overdraft, cash credit and short-term loan. whether taken or repaid.*
- *Share issue expenses / underwriting commission paid.*

*The following items are to be taken when calculating net cash flows from investing activities:*

- *Cash purchase of fixed assets.*
- *Cash sale of fixed assets.*
- *Purchase of shares or debentures or long-term investments of other companies.*
- *Interest and dividend received on shares or debentures or long- term investments of other companies.*
- *Sale of shares or debentures or long- term investments of other companies.*

*The following items are to be taken for cash and cash equivalents:*

- *Cash*
- *Bank*
- *Short term investments*
- *Marketable securities*

**NOTE:**

(i) *Adjustments relating to provision for taxation, proposed dividend, interim dividend, amortization of intangible assets, profit or loss on sale of fixed assets including provision for/accumulated depreciation on them, Profit or loss on sale of investment are also included.*

(ii) *Treatment of proposed dividend:*

(a) *Dividend proposed for the previous year will be an outflow for cash, unless otherwise stated, on the assumption that the proposed amount has been approved by the shareholders in the AGM.*



OR

$$= (\text{Tangible Assets} + \text{Intangible Assets} + \text{Non-Current Investments} + \text{Long Term Loans and Advances}) \\ + \text{Working Capital} - (\text{Long Term Borrowings} + \text{Long Term Provisions})$$

(ii) **Proprietary Ratio:**

$$= \frac{\text{Shareholders Funds/Equity}}{\text{Total Assests}}$$

Total Assets = Non-Current Assets + Current Assets

$$= \text{Tangible Assets} + \text{Intangible Assets} + \text{Non- Current Investments} + \text{Long Term Loans and Advances} + \text{Current Investments} + \text{Inventories (including Loose Tools and Spare Parts)} + \text{Trade Receivables} + \text{Cash and Bank Balance} + \text{Short-term Loans and Advances} + \text{Other Current Assets}$$

(iii) **Debt to Total Assets Ratio:**

$$= \frac{\text{Debt}}{\text{Total Assets}}$$

(iv) **Interest coverage ratio:**

$$= \frac{\text{Net profit before interest and taxes}}{\text{Fixed Interest Charges}}$$

Fixed Interest Charges includes interest on only long-term borrowings.

### C. **Activity Ratios:**

(i) **Trade Receivables Turnover Ratio:**

$$= \frac{\text{Credit Revenue from Operations}}{\text{Average Trade Receivables}}$$

Credit Revenue from Operations = Revenue from Operation – Cash Revenue from Operation

Average Trade Receivables:

$$= \frac{\text{Opening Trade Receivables} + \text{Closing Trade Receivables}}{2}$$

(ii) **Trade Payables Turnover Ratio :**

$$= \frac{\text{Net Credit Purchases}}{\text{Average Trade Payables}}$$

Average Trade Payables:

$$= \frac{\text{Opening trade Payable} + \text{Closing Trade Payable}}{2}$$

(iii) **Working Capital Turnover Ratio :**

$$= \frac{\text{Revenue from Operations}}{\text{Working Capital}}$$



**(iv) Inventory Turnover Ratio :**

$$= \frac{\text{Cost of revenue from Operations}}{\text{Average Inventory}}$$

Cost of Revenue from Operations = Revenue from Operations – Gross Profit

OR

Cost of Material Consumed (including direct expenses) + Change in inventories of WIP and Finished Goods

OR

Opening Inventory + Net Purchases+ Direct Expenses – Closing inventory

Average Inventory:

$$= \frac{\text{Opening Inventory} + \text{Closing Inventory}}{2}$$

**D. Profitability Ratios:**

**(i) Gross Profit Ratio:**

$$= \frac{\text{Gross Profit}}{\text{Revenue from Operations}} \times 100$$

Gross Profit = Revenue from Operations – Cost of Revenue from Operations/ Cost of Goods Sold

Cost of Revenue from Operations = Cost of Material Consumed (including direct expenses) + Change in inventories of WIP and Finished Goods.

OR

Opening Inventory + Net Purchases + Direct Expenses – Closing inventory

**(ii) Net Profit Ratio:**

$$= \frac{\text{Net Profit}}{\text{Revenue from Operations}} \times 100$$

Net Profit = Gross profit + Other Income – Indirect Expenses – Provision for Tax

**(iii) Operating Ratio:**

$$= \frac{\text{Cost of Revenue from Operations} + \text{Operating Expenses}}{\text{Revenue from Operations}} \times 100$$

OR

$$\frac{\text{Cost of Revenue from Operations} + \text{Operating Expenses} - \text{Operating Income}}{\text{Revenue from Operations}} \times 100$$

Operating Expenses = Employee Benefit Expenses + Depreciation of Tangible Assets + Selling and Distribution Expenses+ Office and Administrative Expenses.

Operating Income = Commission received, Cash discount received.

**(iv) Operating Profit Ratio:**

$$= \frac{\text{Net Operating Profit}}{\text{Revenue from Operations}} \times 100$$

Net operating profit = Net Profit after Tax + Provision for Tax + Non-Operating Expenses – Non-Operating Incomes

OR

Gross Profit – Operating Expenses + Operating Incomes

Non-Operating Expenses = Finance Cost (Interest on Long-term Borrowings) + Loss on sale of Non-Current Assets + Amortisation of Intangible Assets + Writing off capital losses

Non-Operating Incomes = Interest and Dividend Received on Investment + Profit on sale of Non-Current Assets.

**(v) Earning per share:**

$$= \frac{\text{Net Profit after Tax and Preference Dividend}}{\text{No. of Equity Shares}}$$

**(vi) Price Earning Ratio:**

$$= \frac{\text{Market Value of an Equity Share}}{\text{Earning per share}}$$

**(vii) Return on Investment:**

$$= \frac{\text{Net Profit before Interest and Tax}}{\text{Capital Employed}} \times 100$$

**NOTE:**

1. Current Ratio includes Net Debtors (Gross Debtors – Provision for doubtful debts) while Trade Receivables Turnover Ratio includes Gross Debtors.
2. Other Current Assets' is restricted to Prepaid Expenses and Accrued Income.
3. Capital employed = Shareholders' Funds + Non-current Liabilities – Non-trade Investments

**OR**

Non-current Assets (excluding Non-trade Investments) + Working Capital

**OR**

Fixed Assets + Trade Investments + Working Capital

4. Investments to be taken as non-trade investments unless specified as trade investments.
5. In Return on Investments Ratio- Net Profit before interest and tax will not include interest on non-trade investments.
6. Revenue from operations (for a manufacturing company)
  - Net Sales
  - Sale of scrap

} For a manufacturing company

Other Income: (for a manufacturing company)

- Rent received (non- operating)
  - Commission received (operating)
  - Interest and Dividend Received (non- operating)
  - Profit from Sale of Fixed Assets (non- operating)
  - Cash discount received (operating)
7. Problems on effect of transactions on ratios to be restricted to Current Ratio, Quick Ratio and Debt-Equity Ratio.
8. Net Profit Ratio is to be calculated on 'Net Profit after Tax'.

## SECTION C

### COMPUTERISED ACCOUNTING

#### 6. Accounting Application of Electronic Spread Sheet

- (i) Concept of Electronic Spreadsheet.

*Meaning, utility, merits and demerits of Electronic spreadsheets.*

- (ii) Features offered by Electronic Spreadsheet.

*An understanding of basic features of electronic spreadsheets such as: Creating worksheet, entering data into worksheet, heading information, data, text, dates, alphanumeric values, saving & quitting worksheet. Opening and moving around in an existing worksheet. Toolbars and Menus, keyboard shortcuts. Working with single and multiple workbooks - copying, renaming, moving, adding and deleting, copying entries and moving between workbooks. Formatting of worksheet- Auto format, changing - alignment, character styles, column width, date format, borders and colours. Previewing and Printing worksheet - Page setting, Print titles, Adjusting margins, Page break, headers and footers. Formulas – summation, subtraction, division, multiplication, average and percentage. Functions: date, if-then- else, freezing panes.*

- (iii) Application of spreadsheets in generating the following accounting information:

1. Payroll

*Components of payroll – Basic, HRA, DA and TA, CCA, deduction for PF and income tax.*

2. Data Presentation

*Graphs and charts- using wizards, various charts type, formatting grid lines and legends, previewing & printing charts*

*Database - creation, sorting, query and filtering a database.*

#### 7. Database Management System (DBMS)

- (i) Concept and Features of DBMS.

*Types and features of DBMS.*

*A conceptual understanding of the basic features of Data Base Management System (DBMS), i.e. data update and retrieval using basic functions and commands of SQL.*

*Basic Commands: Select, Where, And, Or, Update, Delete and*

*Basic Functions: Avg, Count, Max, Min, Sum.*

- (ii) DBMS in Business Application.

*Database design, tables, fields, relationships, forms reports and indexing.*

*The following examples of DBMS in business application:*

- Accounting Information
- Debtors and Creditors
- Bank Reconciliation Statement
- Asset Accounting

## PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

**The project work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project only	3 marks

**A list of suggested Projects is given below:**

1. Preparation of Journal / sub-division of journal, Ledger, Trial balance and Financial Statements of a partnership form of business on the basis of a case study.
  - Develop a case study showing how two or more friends decide to come together and start a business with a certain amount of capital.
  - Prepare their Partnership Deed including interest on capital, partner's salary, commission, interest on drawings, interest on partner's loan and rent paid to a partner.
  - Write in detail, their transactions during the year: purchases - cash and credit, sales - cash and credit, expenses, purchase of fixed assets and depreciation charged on them, any outstanding expenses, prepaid expenses, accrued income, drawing bills of exchange, accepting bills payable etc.
  - From this case study developed (which should have at least 15 transactions), pass the journal entries, post them into the ledger, prepare a Trial Balance and the Trading and Profit and Loss Account, Profit and Loss Appropriation Account and Balance Sheet.
  - The various expenses, for comparison purposes, could be depicted in the form of bar diagrams and pie charts.
  - Calculate relevant accounting ratios like liquidity, solvency, activity and profitability giving their formulae and computation (all this could be part of the viva-voce).
2. Preparation of a Cash Flow Statement with the help of audited / unaudited / imaginary Balance Sheets of a company for two consecutive accounting years or two consecutive quarters of an accounting year could be taken along with at least five additional information (depreciation, purchase/ sale of fixed assets, dividend paid/ proposed, tax paid/ proposed, amortization of intangible assets, profit or loss on sale of fixed assets including provision for depreciation on them and profit or loss on sale of investment).
  - The ratios could also be shown graphically and/ or pictorially (bar diagrams and pie charts) and if possible, could be compared with the ratios of the industry.
  - The results of the operating, investing and financing activities could be shown graphically and/ or pictorially (bar diagrams and pie charts).
3. Preparation of Common Size and Comparative Income Statement and Balance Sheet of a company by taking into account its audited, unaudited / imaginary financial results of two consecutive quarters of an accounting year or of two consecutive accounting years.
  - The comparison has to be made in the form of Common Size and Comparative Income Statement and Balance Sheet.
  - The comparison could also be shown graphically and/ or pictorially (bar diagrams and pie charts).
4. Taking the audited/ unaudited / imaginary financial results of any leading company, its liquidity, solvency, activity and profitability ratios of two consecutive accounting years or of two consecutive quarters of an accounting year should be calculated and the comparison of the ratios of both the years or quarters should be shown graphically and/ or pictorially (bar diagrams and pie charts).
5. Employee Salary Sheet:
  - (i) Design a spreadsheet using the following fields:

Employee's Name: String Variable of maximum size of 40 characters  
Date of Joining: Date in English U.K. format  
Basic Salary: upto 2 places after decimal

Calculate their net salary using the Employee's data. [Feed in random data for 20 to 25 employees]

Some of the instructions are given below:

**Important Instructions:**

Dearness Allowance (DA) is paid @ 45% of Basic Salary.

House Rent Allowance (HRA) is paid @ 15% of (Basic Salary + DA)

City Compensatory Allowance (CCA) is paid @ 8.3% of (Basic Salary + DA + HRA)

Provident Fund (PF) is deducted @ 12% of (Basic Salary + DA)

Income Tax (IT) is deducted @ 10% of (Basic Salary + DA + HRA + CCA)

Net Salary is summation of Basic Salary + DA + HRA + CCA less PF and IT

(ii) Save your worksheet on the desktop as **Employee\_Salary**.

(iii) Print a Hard Copy of your work and close the file.

6. Revenue and Commission Statement

Prepare a Spreadsheet for a certain Company, which pays a commission based upon books sold.

Prepare a revenue and commission statement based upon the following information:

Name of Salesperson	Number of Soft Cover Books sold	Number of Hard Cover Books sold
Suresh Mehta	1546	360
Gladstone David	1788	315
Manish Arora	1340	294
Manmeet Singh	990	450
Vineet Saighal	1105	689

**Assumption:**

Price of Hard Cover Books: @Rs. 34.45 per Book

Price of Soft Cover Books: @ Rs. 22.05 per Book

Commission on Hard Cover Books: 9.0%

Commission on Soft Cover Books: 12%

Prepare a spreadsheet showing your calculation to determine:

(i) Revenue (Hard Cover Books and Soft Cover Books)

(ii) Total Revenue

(iii) Commission (Hard Cover Books and Soft Cover Books)

(iv) Total Commission

(v) Create a Chart (any style) showing the above information.

Open the original page (with lines and shading) as well as a formula page. (The entire formula must be shown)

Use “=round (.0)” where applicable so that all columns add correctly.

7. Spreadsheet on Outstanding Report

Prepare and Present a Spreadsheet for a list of outstanding notes receivable each month. The information for a particular month is as follows:

Use the following financial information:

Face Value	Interest Rate	Other details
0	10.8%	Late Penalty: 11%
500	9.2%	Report date: July 30, 2011
1000	8.96%	Days / Year: 365

Note Number	Face Value	Period Days	Issue Date
1	Rs. 525	90	7/2/2011
2	Rs. 612	60	14/3/2011
3	Rs. 210	45	19/5/2011
4	Rs. 800	120	10/6/2011
5	Rs. 1469	30	24/6/2011

Show the Interest rate, Days outstanding, Interest earned, Late penalty and Total due.

Use appropriate Lines and Shading to make the report interesting and easy to read. Use two places after the decimals where appropriate.

Prepare a chart to show the above information.

8. Database Management

- (i) Create a Database with at least 10 records with each record having the following fields:

Employees Details: PAN Number, Name, Address and Phone Number

- (ii) Sort the names in alphabetical order.
- (iii) The Employee database has another table called Loan Details that stores the details of loan taken by various employees. Create a query that gives a list of employees names along with loan details.

The loan details table has following fields:  
Loan Amount, Loan Date, Interest Rate, Amount Paid and Amount Balance.

- (iv) Create a Report as per the format given below:

Employee Loan Details:

Emp. No.	Emp. Name	Loan Amount	Loan Date	Amount Paid	Balance Amount
----------	-----------	-------------	-----------	-------------	----------------

Decide tables, relationships etc. on your own.

9. Database Management:

- (i) Create an Accounts Table by following the steps given below:
  - (a) Click on the new button and highlight Design View in the dialog box that appears.
  - (b) Click the OK button and the Table Design View will appear.
  - (c) Fill in the Field Name, Data Type and Description for each column/field in the Account Table.

Field Name	Data Type	Description
CustomerID	Number	The Unique Identifier for a Customer
AccountNo	Number	The Unique Identifier for a Bank Account
AccountType	Text	The type of account (Checking, Saving etc.)
DateOpened	Date	The date the account was opened
Balance	Number	The current balance (money) in this account.

- (ii) Define a Primary Key for the Accounts table. Click on the Account Number field with the right mouse button and choose Primary Key from the pop-up menu.

- (iii) Save the new Accounts Table.

10. Selection Grade Card

- (i) Make a Spreadsheet of a Selection Grading Chart using the following details:

<b>Candidate's Name:</b>	<b>String type</b>
Test 1:	Integer type
Test 2:	Integer type
Test 3:	Integer type
Test 4:	Integer type

The Worksheet format is as follows:

S.N.	Name of the Candidate	Test-1 (Max 25 Mks)	Test-2 (Max 25 Mks)	Test-3 (Max 25 Mks)	Test-4 (Max 25 Mks)
1	Alfred Gomes	24	22	18	23
2	Shankar Pandey	17	20	17	20
3	Ali Hassan Raza	22	19	20	14
4	P. Subba Rao	20	19	19	17
5	Sushanto Mukerjee	19	21	24	22

- (ii) Compute the percentage for each candidate's total. Show the total score and the percentage for each candidate.
- (iii) Create a Header for the Chart. Include your name.
- (iv) Save your work on the desktop as **Merit Project**.
- (iv) Print a hard copy of your work and close the file.

**NOTE:** No question paper for Practical work will be set by the Council.

**\*EXPLANATION AND PRESENTATION OF ITEMS UNDER SHAREHOLDERS' FUNDS**

**Share Capital**

Particulars	Note No.	Figures at the end of the current reporting period	Figures at the end of the previous reporting period
1	2	3	4
<b>I. EQUITY AND LIABILITIES</b>			
1. <b>Shareholders Funds</b>			
(a) Share Capital	1	x x x	

Notes to Accounts: 1.

Particulars	Amount (₹)
<b>(a) Share Capital</b>	
Authorised Capital	
..... shares of `..... each	x x x
Issued Capital	
..... shares of `..... each	x x x
(of the above shares.....shares are allotted as fully paid up pursuant to a contract without payment being received in cash)	
Subscribed Capital	
Subscribed and fully paid up	x x x
..... shares of `.... each	x x x
(of the above shares.....shares are allotted as fully paid up pursuant to a contract without payment being received in cash)	
Subscribed but not fully paid up	
..... shares of `.... each, .... ` Called up	x x x
Less calls -in- arrear	(xx)
Add Shares Forfeited A/c	x
<b>TOTAL</b>	<b>x x x</b>

Points to be noted:

- ◆ Equity share capital and preference share capital to be shown separately.  
If the authorised/issued capital is not mentioned in the question it has to be shown in the notes to accounts. However, no figures will be shown as illustrated above.

**\*\*FORMAT OF THE BALANCE SHEET OF A JOINT STOCK COMPANY  
PART-1  
BALANCE SHEET**

Name of the Company.....

Balance Sheet as at.....

(Rupees in .....)

Particulars	Note No.	Figures at the end of the current reporting period	Figures at the end of the previous reporting period
1.	2	3	4.
<b>I. EQUITY AND LIABILITIES</b>			
<b>1. Shareholders Funds</b>			
(a) Share Capital			
(b) Reserves and Surplus			
(c) Money received against share warrants			
<b>2. Share application money pending allotment</b>			
<b>3. Non- Current Liabilities</b>			
(a) Long- term borrowings			
(b) Deferred tax liabilities (Net)			
(c) Other Long term liabilities			
(d) Long-term provisions			
<b>4. Current Liabilities</b>			
(a) Short term borrowings			
(b) Trade payables			
(c) Other current liabilities			
(d) Short term provisions			
<b>TOTAL</b>			
<b>II. ASSETS</b>			
<b>1. Non- Current Assets</b>			
(a) Fixed Assets			
(i) Tangible Assets			
(ii) Intangible Assets			
(iii) Capital work-in- progress			
(iv) Intangible assets under development			
(b) Non-current Investments			
(c) Deferred Tax Assets (Net)			
(d) Long term loans and advances			
(e) Other non-current assets			
<b>2. Current Assets</b>			
(a) Current Investments			
(b) Inventories			
(c) Trade Receivables			
(d) Cash and Bank Balance			
(e) Short-term loans and advances			
(f) Other current assets			
<b>TOTAL</b>			



### SAMPLE TABLE FOR PRACTICAL WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	PROJECT 1					PROJECT 2					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)	
		7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

*Breakup of 7 Marks to be awarded separately by the Teacher and the Visiting Examiner is as follows:		Name of Teacher:	
Overall Format	1 Mark	Signature:	Date
Content	4 Marks	Name of Visiting Examiner	
Findings	2 Marks	Signature:	Date

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner, and should be based on the Project only**

# BUSINESS STUDIES (859)

## Aims

1. To enable candidates to understand the modern business environment and to create awareness about various entrepreneurial opportunities.
2. To awaken a spirit of enterprise amongst candidates.
3. To provide an insight into the recent trends in business.
4. To acquaint candidates with the various aspects of Human Resource Management.
5. To provide knowledge and understanding of communication in modern business.
6. To identify the various sources of business finance and the role of regulators and intermediaries.

## CLASS XI

There will be **two** papers in the subject:

**Paper I - Theory:** 3 hours .....80 marks

**Paper II- Project Work** .....20 marks

### **PAPER – I (THEORY): 80 Marks**

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary/ fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions, out of which candidates will be required to answer **any five** questions, each carrying **12 marks**.

### **1. Business Environment**

- (i) Introduction to the concept of business environment.

*Meaning and definition of business environment.*

- (ii) Features and importance of business environment.

*Features: dynamic, relative, inter related, complex, uncertain, totality of internal and external forces, general and specific forces, universality, various stakeholders;*

*Need to understand business environment: first mover advantage, early warning signals, business strategies, competitive advantage, customer confidence and public image, coping with change, customer needs, keeping pace with consumerism. PESTLE analysis and Porter's five factor analysis in understanding the business environment.*

- (iii) SWOT Analysis

*Meaning and importance of SWOT analysis. Components of SWOT.*

### **2. Entrepreneurship**

- (i) Introduction to Entrepreneur.

*Meaning and definition of entrepreneur; Classification of entrepreneurs: independent and spin-off; types of entrepreneurs as given by Clarence Danhof: Innovative, Imitating, Fabian and Drone.*

- (ii) Introduction to Entrepreneurship.

*Meaning, definition and characteristics of entrepreneurship. Characteristics of successful entrepreneur: forward looking, hardworking, passionate, opinionated, confident, resourceful, positive; Factors affecting entrepreneurship: political, statutory (legal and taxation), capital availability, availability of required labour, availability of required raw material; Types of entrepreneurship: small business, scalable startup, large company, social.*

- (iii) Intrapreneurship

*Meaning, definition and characteristics of intrapreneurship; Differences between entrepreneurship and intrapreneurship; Classification of intrapreneurs: venture and project; factors affecting entrepreneurship; management support, resource availability, organization structure, risk taking capacity, reward.*

- (iv) Enterprise

*Meaning and definition; steps in setting up an enterprise: selecting the line of business, choosing the form of ownership, locating the appropriate site to set up the business, financing the proposition (identifying*

capital requirements and its sources), setting up the physical layout and the facilities, acquiring required human resource. Compliance with statutory requirements, launching the business). Five phases of a business: expansion, peak, recession, trough, recovery.

Startup business – meaning only.

(v) Business risks and causes of failure.

*Meaning of business risks. Types of business risks: strategic risks, financial risks, operational risks, compliance risks, competition and market risks, environmental risks, reputational risks, credit risks, innovation risks: a brief explanation of each.*

*Causes of business failure: internal causes (poor management, premature scaling, funding shortfall, inadequate profits, labour problems, small customer base) and external forces (economy fluctuations, market fluctuations, non-availability of credit, change in technology, change in government policies and laws, natural disasters, lack of availability of raw material).*

*Methods of managing business risk: accept and absorb, avoid, transfer, mitigate, exploit (clear understanding of the methods).*

### 3. Managers and Managerial Roles

(i) Introduction

*Meaning and definition of a Manager.*

(ii) Managerial roles

*Managerial roles as given by Mintzberg: informational (monitor, disseminator, spokesperson), interpersonal (figurehead, leader, and liaison), and decisional (entrepreneur, disturbance handler, resource allocator, negotiator): brief explanation of these roles.*

(iii) Authority, responsibility, and accountability.

*Meaning and definition of authority, responsibility, and accountability; their interrelationship; authority distinguished from power; sources of authority: formal, acceptance, competence; delegation of authority; Principles of delegation of*

*authority; Centralization and decentralization of authority; Distinction between delegation and decentralization of authority.*

(iv) Change management.

*Meaning and definition of change management; Types of change: developmental, transitional, transformational.*

*Need for change: Internal forces (need for improving productivity, need to reduce costs, need for improving quality of work life, Domino effect, deficiency in the existing system, to enhance innovation); External forces (change in market situations - national and international, changes in technology, changes in population dynamics, changes in the political scenario, changes in the legal system).*

*Resistance to change: reasons for resistance to change - Individual reasons (habits and conventions, fear of unknown, zero tolerance to change (status quo), fear of economic loss, redundancy of skills, egoistic attitude, peer pressure, emotional resistance to change in social groups); Organizational reasons (fear of the unknown, costs involved, management's lack of faith in change, constraints of organizational structure).*

*Overcoming resistance to change: Brief explanation of Kurt Lewin's model of change and ADKAR model of change.*

### 4. Automation at Workplaces

(i) Introduction

*Meaning and definition of mechanization and automation; distinction between the two; evolution from mechanization to automation; merits and demerits of mechanization; merits and demerits of automation.*

(ii) Productivity enhancement tools and facilities at different workplaces.

- Banks: ATM, passbook printing kiosk, cheque/ cash depositing machine, SMS alerts

- *Retail Industry: barcode scanner and POS machine (Point of Sale), card swipe machine*
- *Corporate Office: Biometric system, photocopy machine, LED Projector, scanners, laptops, smartphones. Video conferencing, intercom, internet and wi-fi, VoIP (voice-over internet protocol).*
- *Airports: self check-in kiosk, CUTE workstations, automated backdrop, AODB solutions, Airport hub wireless, Advanced ATS.*

*A basic understanding of role of each of the above in enhancing productivity (details of functioning not required).*

## **PAPER II - PROJECT WORK: 20 Marks**

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

### **A list of suggested Projects is given below:**

1. Study the importance of changes in the business environment. Examine any two companies that had first mover advantage in Indian business environment and how they reacted to entry of global competition.
2. Study and compare SWOT analysis of two leading public sector companies from different industries.
3. As a fresh graduate, select a business opportunity and prepare a business plan for a startup business giving the following:
  - Details of the business idea
  - Products and/or services
  - Finance and its sources
  - Marketing plan
4. Explain how promotion of startups contributes to the economic growth of the country. Consider different aspects such as:
  - Employment generation
  - Mobility of labour
  - Capital formation
5. Select one firm each from any two different industries (e.g. banking, retail, hotel, pharmaceuticals, tourism, automobile, cement, steel). Analyse the business risks for each of the two firms selected by you. As an efficient manager, how would you mitigate such risks?
6. List any two businesses in different industries that have failed drastically and study the reasons for their failure. You may consider aspects such as, Finance, Marketing, Operational inefficiency, Managerial inefficiency, etc.
7. Your organization is revamping its processes from manual to automated mode. There is a lot of resistance from the workers. As a senior manager, state how would you overcome this resistance. Discuss on the basis of the following points:
  - The nature of business
  - Changes that you would propose in the process
  - Positive and negative points for the stakeholders
  - Benefits of the change to the employees
  - Unfreeze Change and Refreeze model for your change management
  - Retention policies
  - Conclusion
8. Bring out in detail the upcoming innovations in any two industries e.g. automobile, education, retail, aviation, hospitality, tourism.
9. Make a list of various productivity enhancement tools and facilities available to banking industry and retail business. Study two banks and two departmental stores and examine if they are using the facilities available to them. Evaluate the benefits availed by the firm and the customers.
10. Study the productivity enhancement tools and facilities used by corporate world. Examine how it has helped the corporate world perform and serve better.

## CLASS XII

There will be **two** papers in the subject:

**Paper I** - Theory: 3 hours ..... 80 marks

**Paper II** - Project Work ..... 20 marks

### PAPER - I (THEORY): 80 Marks

**Part I (20 marks)** will consist of **compulsory** short answer questions testing knowledge, application and skills relating to elementary / fundamental aspects of the entire syllabus.

**Part II (60 marks)** will consist of **eight** questions, out of which candidates will be required to answer **any five** questions, each carrying **12 marks**.

### 1. Human Resource Management

- (i) Introduction to Human Resource Management.

*Meaning and definition of Human Resource Management; Characteristics of Human Resource Management: people oriented, comprehensive function, staff function, pervasive, challenging, continuous, individual oriented, development oriented, action oriented, future oriented, interdisciplinary, art as well as science, young discipline; Importance of human resource management.*

- (ii) Job and Manpower planning.

*Meaning, relevance and difference between the following: Job Analysis, Job Specification, Job Description, Job Enrichment and Job Enlargement, Manpower Estimation.*

- (iii) Staff Recruitment.

*Meaning, definition and characteristics of staff recruitment; sources of recruitment: internal sources (promotion, transfer, ex-employees, recommendation by employees); external sources (advertisements, campus recruitment, casual callers, gate hiring, employment exchanges, placement agencies, labour contractors). Differences between internal and external sources of recruitment, their merits and demerits; e-recruitment: concept, benefits and limitations; sources of e-recruitment: internet and intranet (their benefits and limitations).*

- (iv) Staff Selection.

*Meaning and definition of staff selection; Selection procedures (preliminary screening, application blank, selection test, Group discussion, final interview, medical test, reference check, final approval, placement; brief explanation and importance of each step of the selection procedure); distinction between recruitment and selection.*

- (v) Staff Training.

*Meaning and definition of training; distinction between training, education and development; types of training (induction, job, remedial, safety, promotional, refresher- brief explanation of each.); methods of training: on the job and off the job (vestibule, apprenticeship, internship, classroom); Distinction between on the job and off the job training. Hindrances to training: brief explanation. Benefits of training to employer and employees.*

- (vi) Staff Morale.

*Meaning, definition and characteristics of staff morale; Morale Productivity Matrix (brief explanation of the four situations); factors influencing morale (morale depressants and stimulants: an understanding of how the same factor may lower or boost morale); methods of raising morale; indicators of low and high morale; advantages of high morale; disadvantages of low morale.*

- (vii) Staff Motivation.

*Meaning, definition and characteristics of staff motivation; difference between motivation and morale; importance of staff motivation to the employer and the employee ; factors influencing motivation: monetary and non-monetary incentives; differences between monetary and non-monetary incentives; Maslow's theory of the Hierarchy of Human Needs (explanation of the theory with the help of the pyramid, assumptions and criticism of the theory); Herzberg's Two-factor Theory (Motivation and Hygiene Factors).*

(viii) Staff Remuneration.

*Meaning and definition of Staff remuneration, Methods of wage payment – Time Rate and Piece Rate System (An explanation of the two systems along with their merits, demerits and suitability, differences between the two); Pay Slip and Payroll - Meaning, Differences, Components, Specimens of both. Various staff benefits: Employee Provident Fund, National Pension System, Group Insurance (medical and life), encashment of leave, gratuity, (basic understanding only). Types of leaves (casual, medical/sick, earned / privilege, maternity/ paternity, sabbatical/ study, leave without pay: basic understanding only)*

(ix) Staff Leadership.

*Meaning and definition of staff leadership; Distinction between Leadership and Management; Leadership styles: Autocratic, Democratic, Laissez-Faire (brief explanation, advantages, disadvantages and comparison between each style); Leadership continuum (brief description); Situational leadership (brief description); Blake & Mouton Managerial Grid (brief explanation).*

(x) Staff Appraisal.

*Meaning and definition of Performance Appraisal and Potential Appraisal; Distinction between the two; Objectives and importance of Performance Appraisal, Methods of Performance Appraisal - merit grading, appraisal by results, appraisal by superior staff: self-appraisal; 360° appraisal (brief explanation of each method and their respective advantages and disadvantages).*

(xi) Staff Promotion and Transfer.

*Staff Promotion - Meaning, definition, benefits and limitations of promotion; Open and Closed policy of promotion (meaning and differences); a brief understanding of the concept of Dry promotion and upgrading and distinction between the two; requirements of a sound promotion policy; Basis of promotion: seniority, merit,*

*seniority-cum-merit (brief explanation of each and the advantages, disadvantages, comparison between seniority basis and merit basis.)*

*Staff Transfer: Meaning, definition and need for transfer; Types of transfers: replacement, versatility, remedial, production (meaning and relevance of each type).*

(xii) Staff Separation.

*Meaning of Staff separation; means of staff separation: Retirement (Compulsory and Voluntary), Lay off, Retrenchment, Resignation, Suspension (Meaning and distinction only), Dismissal: grounds for dismissal, procedure for staff dismissal.*

*Exit Interview-Meaning and importance.*

(xiii) Emerging trends in Human Resources.

*Flexible Hours, Permanent part time, Work from home, Retainership, Virtual teams, Self-managing teams (SMTs) - only meaning of the above terms.*

## **2. Business Communication and Correspondence**

(i) Business Communication

*Meaning and definition of communication; importance of communication in business, elements of the Communication Process, Methods of communication: Oral, Written, Gestural, Visual (Meaning, advantages and disadvantages of all these methods), Difference between oral and written communication, Types of communication: On the basis of area of operation (Internal and External), on the basis of relationship (Formal and Informal), on the basis of direction (Horizontal, Vertical-upwards and downwards, Diagonal), Meaning, Advantages and Disadvantages of each; distinction between - Internal and External; Formal and Informal; Horizontal and Vertical Communication; Barriers to Communication (Semantic, Physical and Mechanical, Organisational, Socio-Psychological: meaning only, detailed explanation not required); overcoming the barriers to communication.*

(ii) Business Correspondence

*Need and functions of business correspondence.*

**Business Letters**

*Elements and contents of various business letters; types of letters: solicited and unsolicited letters of application for a job, along with drafting of biodata; Interview letter, Offer of Appointment, Letter of resignation, Letter of enquiry, Quotation letter, Order letter, Complaint letter, Reply to Complaint letter).*

**NOTE:** *Candidates should be able to draft all of the above types of letters, using the appropriate format.*

**Reports**

*Meaning and definition of Reports; types of reports: statutory, non- statutory, private, public, informational, interpretative, routine/periodic, special; brief explanation of each type of report; differences between statutory and non-statutory, private and public, informational and interpretative, routine/periodic and special report. Format of report (report writing not required).*

(iii) Current trends in Business Communication: e-mail and video conferencing.

*Meaning and uses of e-mail and video conferencing.*

**3. Business Size and Finance**

(i) Various business entities.

*Meaning, definition and distinction between sole proprietorship, partnership, private limited company and public limited company.*

(ii) Sources of business finance

*A basic understanding of the following: Equity and preference shares, debentures and bonds, retained profits, public deposits, loans, trade credit, discounting of bills of exchange, global depository receipt, Angel investors, venture capitalists, crowd funding, peer to peer funding, factoring.*

**4. Globalisation and recent trends in Business**

(i) Globalisation.

*Meaning, nature, opportunities and threats of globalization for business; brief understanding of how globalization has been instrumental in transforming the manner in which Business is conducted.*

(ii) e-Business.

*Meaning, nature and importance of e- business to the buyer and to the seller.*

(iii) Outsourcing.

*Concept of outsourcing; Parties involved – the outsourcer, the outsourced and the service provider – the respective advantages and disadvantages of each of the above.*

(iv) Types of Outsourcing.

*Business Process Outsourcing (BPO), Knowledge Process Outsourcing (KPO), and Business Legal Process Outsourcing (LPO).*

*Basic understanding of the above.*

(v) Online means of conducting business.

*Business to Consumer (B2C), Consumer to Consumer (C2C), Business to Business (B2B), Intra Business (Intra B) and, Business to Government (B2G), Government to Business (G2B).*

*Basic understanding of the above with a few examples.*

**5. Business Regulators and Intermediaries**

(i) Regulators and Intermediaries.

*Meaning of the terms Regulators and Intermediaries.*

(ii) Role of Regulators and Intermediaries.

(a) *Reserve Bank of India (RBI): Indian banks, foreign banks, Non-Banking Financial Companies (NBFC).*

(b) *Securities and Exchange Board of India (SEBI): stock exchanges, stock brokers, merchant bankers, depositories, mutual funds and credit rating agencies.*

- (c) *Insurance Regulatory and Development Authority of India (IRDA): insurance companies, insurance agents and insurance brokers.*
- (d) *Food Safety and Standards Authority of India (FSSAI): food processors, food packers.*
- (e) *Bureau of Indian Standards (BIS): ISI mark given to industrial goods, consumer electrical goods, steel manufacturers.*

*Only a basic understanding of the roles of the above regulators and intermediaries.*

**PAPER II – PROJECT WORK: 20 Marks**

Candidates will be expected to have completed **two** projects from any topic covered in Theory.

**The project work will be assessed by the teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks

**A list of suggested Projects is given below:**

- 1. Analyse the recruitment process in any two companies of your choice. List the loopholes if any and give suggestions for improving the process. (You may also make a comparative study of the recruitment process).
- 2. Evaluate the selection process of any two firms from the corporate world and discuss their benefits and drawbacks vis-a-vis each other.

- 3. Study any two business organizations (one Multi National Company and one Indian Company) with regards to their Policies of Compensation (Increment policy, Incentive policy, Bonus and reward policy, retirement benefits).
- 4. Study the various types of leaves made available to employees. Leaves can be considered as financial cost to the organization. What other tangible and non-tangible benefits does the organization stand to gain from incurring this cost? Do the benefits justify the cost?
- 5. Consider any two successful business leaders. Give a brief account of their leadership styles. Explain the impact of their leadership styles in the achievement of the organizational goals of their respective organisations.
- 6. Analyse the emerging trends in human resource management and discuss their implementation in India (Comparative study of five organisations).
- 7. Make a comparative study of any two E-Businesses in terms of their Nature, Size, Products and Services offered, Functioning and Policies.
- 8. Select any two companies and study their sources of finance with respect to the amount procured and advantages and disadvantages of each source of finance
- 9. Select any BPO or KPO and explain the outsourced functions that it performs. Discuss the impact of outsourcing in general and specifically on the profitability of the outsourcing organization.
- 10. Study any one regulator and the intermediaries under it. Give an account of their functions and how it helps the common man.

**NOTE:** No question paper for Project work will be set by the Council.



## SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	<u>PROJECT 1</u>					<u>PROJECT 2</u>					TOTAL MARKS	
		A	B	C	D	E	F	G	H	I	J		
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)		(E + J)
		7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks		20 Marks
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													

<b>*Breakup of 7 Marks to be awarded separately by the Teacher and the Visiting Examiner is as follows:</b>		<b>Name of Teacher:</b> <b>Signature:</b> _____ <b>Date</b> _____
<b>Overall Format</b>	<b>1 Mark</b>	<b>Name of Visiting Examiner</b> <b>Signature:</b> _____ <b>Date</b> _____
<b>Content</b>	<b>4 Marks</b>	
<b>Findings</b>	<b>2 Marks</b>	

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner, and should be based on the Project only**

# MATHEMATICS (860)

## Aims:

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, concepts, symbols, definitions, principles, processes and formulae of Mathematics at the Senior Secondary stage.
2. To develop the ability to apply the knowledge and understanding of Mathematics to unfamiliar situations or to new problems.
3. To develop an interest in Mathematics.
4. To enhance ability of analytical and rational thinking in young minds.
5. To develop skills of -
  - (a) Computation.
  - (b) Logical thinking.
  - (c) Handling abstractions.
  - (d) Generalizing patterns.
  - (e) Solving problems using multiple methods.
  - (f) Reading tables, charts, graphs, etc.
6. To develop an appreciation of the role of Mathematics in day-to-day life.
7. To develop a scientific attitude through the study of Mathematics.

A knowledge of Arithmetic, Basic Algebra (Formulae, Factorization etc.), Basic Trigonometry and Pure Geometry is assumed.

As regards to the standard of algebraic manipulation, students should be taught:

- (i) To check every step before proceeding to the next particularly where minus signs are involved.
- (ii) To attack simplification piecemeal rather than en block.
- (iii) To observe and act on any special features of algebraic form that may be obviously present.

## CLASS XI

There will be **two** papers in the subject:

**Paper I** : Theory (3 hours) .....80 marks

**Paper II**: Project Work .....20 marks

### PAPER I (THEORY) – 80 Marks

The syllabus is divided into **three** sections A, B and C.

Section A is compulsory for all candidates. Candidates will have a choice of attempting questions from **EITHER** Section B **OR** Section C.

There will be one paper of **three** hours duration of 80 marks.

**Section A (65 Marks)**: Candidates will be required to attempt **all** questions. Internal choice will be provided in two questions of two marks, two questions of four marks and two questions of six marks each.

**Section B/ Section C (15 Marks)**: Candidates will be required to attempt **all** questions **EITHER** from Section B or Section C. Internal choice will be provided in one question of two marks and one question of four marks.

### DISTRIBUTION OF MARKS FOR THE THEORY PAPER

S.No.	UNIT	TOTAL WEIGHTAGE
<b>SECTION A: 65 Marks</b>		
1.	Sets and Functions	20 Marks
2.	Algebra	24 Marks
3.	Coordinate Geometry	8 Marks
4.	Calculus	6 Marks
5.	Statistics & Probability	7 Marks
<b>SECTION B: 15 marks</b>		
6.	Conic Section	7 Marks
7.	Introduction to Three-Dimensional Geometry	5 Marks
8.	Mathematical Reasoning	3 Marks
<b>OR</b>		
<b>SECTION C: 15 Marks</b>		
9.	Statistics	5 Marks
10.	Correlation Analysis	4 Marks
11.	Index Numbers & Moving Averages	6 Marks
	<b>TOTAL</b>	<b>80 Marks</b>

## SECTION A

### 1. Sets and Functions

#### (i) Sets

Sets and their representations. Empty set. Finite and Infinite sets. Equal sets. Subsets. Subsets of a set of real numbers especially intervals (with notations). Power set. Universal set. Venn diagrams. Union and Intersection of sets. Practical problems on union and intersection of two and three sets. Difference of sets. Complement of a set. Properties of Complement of Sets.

#### (ii) Relations & Functions

Ordered pairs, Cartesian product of sets. Number of elements in the cartesian product of two finite sets. Cartesian product of the set of reals with itself (upto  $\mathbb{R} \times \mathbb{R} \times \mathbb{R}$ ). Definition of relation, pictorial diagrams, domain, co-domain and range of a relation. Function as a special type of relation. Function as a type of mapping, types of functions (one to one, many to one, onto, into) domain, co-domain and range of a function. Real valued functions, domain and range of these functions, constant, identity, polynomial, rational, modulus, signum, exponential, logarithmic and greatest integer functions, with their graphs. Sum, difference, product and quotient of functions.

- *Sets: Self-explanatory.*
- **Basic concepts of Relations and Functions**

- *Ordered pairs, sets of ordered pairs.*
- *Cartesian Product (Cross) of two sets, cardinal number of a cross product.*

*Relations as:*

- *an association between two sets.*
- *a subset of a Cross Product.*
- *Domain, Range and Co-domain of a Relation.*
- *Functions:*

- *As special relations, concept of writing “y is a function of x” as  $y = f(x)$ .*
- *Introduction of Types: one to one, many to one, into, onto.*
- *Domain and range of a function.*
- *Sketches of graphs of exponential function, logarithmic function, modulus function, step function and rational function.*

#### (iii) Trigonometry

Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Truth of the identity  $\sin^2 x + \cos^2 x = 1$ , for all x. Signs of trigonometric functions. Domain and range of trigonometric functions and their graphs. Expressing  $\sin(x \pm y)$  and  $\cos(x \pm y)$  in terms of  $\sin x$ ,  $\sin y$ ,  $\cos x$  &  $\cos y$  and their simple applications. Deducing the identities like the following:

$$\tan(x \pm y) = \frac{\tan x \pm \tan y}{1 \mp \tan x \tan y},$$

$$\cot(x \pm y) = \frac{\cot x \cot y \mp 1}{\cot y \pm \cot x}$$

$$\sin \alpha \pm \sin \beta = 2 \sin \frac{1}{2}(\alpha \pm \beta) \cos \frac{1}{2}(\alpha \mp \beta)$$

$$\cos \alpha + \cos \beta = 2 \cos \frac{1}{2}(\alpha + \beta) \cos \frac{1}{2}(\alpha - \beta)$$

$$\cos \alpha - \cos \beta = -2 \sin \frac{1}{2}(\alpha + \beta) \sin \frac{1}{2}(\alpha - \beta)$$

Identities related to  $\sin 2x$ ,  $\cos 2x$ ,  $\tan 2x$ ,  $\sin 3x$ ,  $\cos 3x$  and  $\tan 3x$ . General solution of trigonometric equations of the type  $\sin y = \sin a$ ,  $\cos y = \cos a$  and  $\tan y = \tan a$ . Properties of triangles (proof and simple applications of sine rule cosine rule and area of triangle).

- **Angles and Arc lengths**
  - Angles: Convention of sign of angles.
  - Magnitude of an angle: Measures of Angles; Circular measure.
  - The relation  $S = r\theta$  where  $\theta$  is in radians. Relation between radians and degree.
  - Definition of trigonometric functions with the help of unit circle.
  - Truth of the identity  $\sin^2x + \cos^2x = 1$

**NOTE:** Questions on the area of a sector of a circle are required to be covered.

- **Trigonometric Functions**
  - Relationship between trigonometric functions.
  - Proving simple identities.
  - Signs of trigonometric functions.
  - Domain and range of the trigonometric functions.
  - Trigonometric functions of all angles.
  - Periods of trigonometric functions.
  - Graphs of simple trigonometric functions (only sketches).

**NOTE:** Graphs of  $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $\sec x$ ,  $\operatorname{cosec} x$  and  $\cot x$  are to be included.

- **Compound and multiple angles**
  - Addition and subtraction formula:  $\sin(A \pm B)$ ;  $\cos(A \pm B)$ ;  $\tan(A \pm B)$ ;  $\tan(A + B + C)$  etc., Double angle, triple angle, half angle and one third angle formula as special cases.
  - Sum and differences as products  

$$\sin C + \sin D = 2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right), \text{ etc.}$$
  - Product to sum or difference i.e.  $2\sin A \cos B = \sin(A+B) + \sin(A-B)$  etc.

### Trigonometric Equations

- Solution of trigonometric equations (General solution and solution in the specified range).

- Equations expressible in terms of  $\sin\theta = 0$  etc.
- Equations expressible in terms i.e.  $\sin\theta = \sin\alpha$  etc.
- Equations expressible multiple and sub-multiple angles i.e.  $\sin^2\theta = \sin^2\alpha$  etc.
- Linear equations of the form  $a \cos\theta + b \sin\theta = c$ , where  $|c| \leq \sqrt{a^2 + b^2}$  and  $a, b \neq 0$
- Properties of  $\Delta$

$$\text{Sine formula: } \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C};$$

$$\text{Cosine formula: } \cos A = \frac{b^2 + c^2 - a^2}{2bc}, \text{ etc}$$

$$\text{Area of triangle: } \Delta = \frac{1}{2}bc \sin A, \text{ etc}$$

Simple applications of the above.

## 2. Algebra

### (i) Principle of Mathematical Induction

Process of the proof by induction, motivating the application of the method by looking at natural numbers as the least inductive subset of real numbers. The principle of mathematical induction and simple applications.

*Using induction to prove various summations, divisibility and inequalities of algebraic expressions only.*

### (ii) Complex Numbers

Introduction of complex numbers and their representation, Algebraic properties of complex numbers. Argand plane and polar representation of complex numbers. Square root of a complex number. Cube root of unity.

- Conjugate, modulus and argument of complex numbers and their properties.
- Sum, difference, product and quotient of two complex numbers additive and multiplicative inverse of a complex number.

- Locus questions on complex numbers.
- Triangle inequality.
- Square root of a complex number.
- Cube roots of unity and their properties.

(iii) Quadratic Equations

Statement of Fundamental Theorem of Algebra, solution of quadratic equations (with real coefficients).

- Use of the formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

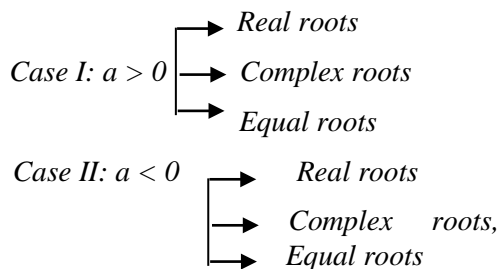
In solving quadratic equations.

- Equations reducible to quadratic form.
- Nature of roots
  - Product and sum of roots.
  - Roots are rational, irrational, equal, reciprocal, one square of the other.
  - Complex roots.
  - Framing quadratic equations with given roots.

**NOTE:** Questions on equations having common roots are to be covered.

- **Quadratic Functions.**

Given  $\alpha, \beta$  as roots then find the equation whose roots are of the form  $\alpha^3, \beta^3$ , etc.



Where 'a' is the coefficient of  $x^2$  in the equations of the form  $ax^2 + bx + c = 0$ .

Understanding the fact that a quadratic expression (when plotted on a graph) is a parabola.

- **Sign of quadratic**

Sign when the roots are real and when they are complex.

- **Inequalities**

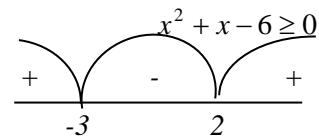
- Linear Inequalities

Algebraic solutions of linear inequalities in one variable and their representation on the number line. Graphical representation of linear inequalities in two variables. Graphical method of finding a solution of system of linear inequalities in two variables.

*Self-explanatory.*

- Quadratic Inequalities

Using method of intervals for solving problems of the type:



A perfect square e.g.  $x^2 - 6x + 9 \geq 0$ .

- Inequalities involving rational expression of type

$$\frac{f(x)}{g(x)} \leq a . \text{ etc. to be covered.}$$

(iv) Permutations and Combinations

Fundamental principle of counting. Factorial n. (n!) Permutations and combinations, derivation of formulae for  ${}^n P_r$  and  ${}^n C_r$  and their connections, simple application.

- Factorial notation  $n!$ ,  $n! = n(n-1)!$
- Fundamental principle of counting.
- Permutations
  - ${}^n P_r$ .
  - Restricted permutation.
  - Certain things always occur together.
  - Certain things never occur.
  - Formation of numbers with digits.
  - Word building - repeated letters - No letters repeated.
  - Permutation of alike things.
  - Permutation of Repeated things.
  - Circular permutation – clockwise counterclockwise – Distinguishable / not distinguishable.

- **Combinations**

- ${}^n C_r, {}^n C_n = 1, {}^n C_0 = 1, {}^n C_r = {}^n C_{n-r}, {}^n C_x = {}^n C_y$ , then  $x + y = n$  or  $x = y$ ,  ${}^{n+1} C_r = {}^n C_{r-1} + {}^n C_r$ .
- When all things are different.
- When all things are not different.
- Mixed problems on permutation and combinations.

(v) Binomial Theorem

History, statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, General and middle term in binomial expansion, simple applications.

- Significance of Pascal's triangle.
- Binomial theorem (proof using induction) for positive integral powers,

i.e.  $(x + y)^n = {}^n C_0 x^n + {}^n C_1 x^{n-1} y + \dots + {}^n C_n y^n$ .

Questions based on the above.

(vi) Sequence and Series

Sequence and Series. Arithmetic Progression (A. P.). Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a G.P., sum of first  $n$  terms of a G.P., infinite G.P. and its sum, geometric mean (G.M.), relation between A.M. and G.M. Formulae for the following special sums  $\sum n, \sum n^2, \sum n^3$ .

- **Arithmetic Progression (A.P.)**
  - $T_n = a + (n - 1)d$
  - $S_n = \frac{n}{2} \{2a + (n - 1)d\}$
  - Arithmetic mean:  $2b = a + c$
  - Inserting two or more arithmetic means between any two numbers.
  - Three terms in A.P. :  $a - d, a, a + d$
  - Four terms in A.P.:  $a - 3d, a - d, a + d, a + 3d$
- **Geometric Progression (G.P.)**

$$T_n = ar^{n-1}, S_n = \frac{a(r^n - 1)}{r - 1},$$

$$S_\infty = \frac{a}{1 - r}; |r| < 1 \quad \text{Geometric}$$

Mean,  $b = \sqrt{ac}$

- Inserting two or more Geometric Means between any two numbers.
- Three terms are in G.P.  $ar, a, ar^{-1}$
- Four terms are in GP  $ar^3, ar, ar^{-1}, ar^{-3}$

- **Arithmetico Geometric Series**

Identifying series as A.G.P. (when we substitute  $d = 0$  in the series, we get a G.P. and when we substitute  $r = 1$  the A.P).

- Special sums  $\sum n, \sum n^2, \sum n^3$

Using these summations to sum up other related expression.

### 3. Coordinate Geometry

(i) Straight Lines

Brief recall of two-dimensional geometry from earlier classes. Shifting of origin. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axis, point-slope form, slope-intercept form, two-point form, intercept form and normal form. General equation of a line. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line.

- **Basic concepts of Points and their coordinates.**
- **The straight line**
  - Slope or gradient of a line.
  - Angle between two lines.
  - Condition of perpendicularity and parallelism.
  - Various forms of equation of lines.
  - Slope intercept form.
  - Two-point slope form.
  - Intercept form.
  - Perpendicular /normal form.

- General equation of a line.
- Distance of a point from a line.
- Distance between parallel lines.
- Equation of lines bisecting the angle between two lines.
- Equation of family of lines
- Definition of a locus.
- Equation of a locus.

(ii) Circles

- Equations of a circle in:
  - Standard form.
  - Diameter form.
  - General form.
  - Parametric form.
- Given the equation of a circle, to find the centre and the radius.
- Finding the equation of a circle.
  - Given three non collinear points.
  - Given other sufficient data for example centre is  $(h, k)$  and it lies on a line and two points on the circle are given, etc.
- Tangents:
  - Condition for tangency
  - Equation of a tangent to a circle

**4. Calculus**

(i) Limits and Derivatives

Derivative introduced as rate of change both as that of distance function and geometrically.

Intuitive idea of limit. Limits of polynomials and rational functions trigonometric, exponential and logarithmic functions. Definition of derivative relate it to slope of tangent of the curve, Derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions.

- Limits
  - Notion and meaning of limits.
  - Fundamental theorems on limits (statement only).

- Limits of algebraic and trigonometric functions.
- Limits involving exponential and logarithmic functions.

**NOTE:** Indeterminate forms are to be introduced while calculating limits.

- Differentiation
  - Meaning and geometrical interpretation of derivative.
  - Derivatives of simple algebraic and trigonometric functions and their formulae.
  - Differentiation using first principles.
  - Derivatives of sum/difference.
  - Derivatives of product of functions. Derivatives of quotients of functions.

**5. Statistics and Probability**

(i) Statistics

Measures of dispersion: range, mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

- Mean deviation about mean and median.
- Standard deviation - by direct method, short cut method and step deviation method.

**NOTE:** Mean, Median and Mode of grouped and ungrouped data are required to be covered.

(ii) Probability

Random experiments; outcomes, sample spaces (set representation). Events; occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, Axiomatic (set theoretic) probability, connections with other theories studied in earlier classes. Probability of an event, probability of 'not', 'and' and 'or' events.

- Random experiments and their outcomes.
- Events: sure events, impossible events, mutually exclusive and exhaustive events.
  - Definition of probability of an event
  - Laws of probability addition theorem.



## SECTION B

### 6. Conic Section

Sections of a cone, ellipse, parabola, hyperbola, a point, a straight line and a pair of intersecting lines as a degenerated case of a conic section. Standard equations and simple properties of parabola, ellipse and hyperbola.

- *Conics as a section of a cone.*

- *Definition of Foci, Directrix, Latus Rectum.*
- *$PS = ePL$  where  $P$  is a point on the conics,  $S$  is the focus,  $PL$  is the perpendicular distance of the point from the directrix.*

- (i) *Parabola*

$$e=1, y^2 = \pm 4ax, x^2 = 4ay, y^2 = -4ax,$$

$$x^2 = -4ay, (y - \beta)^2 = \pm 4a(x - \alpha),$$

$$(x - \alpha)^2 = \pm 4a(y - \beta).$$

- *Rough sketch of the above.*
- *The latus rectum; quadrants they lie in; coordinates of focus and vertex; and equations of directrix and the axis.*
- *Finding equation of Parabola when Foci and directrix are given, etc.*
- *Application questions based on the above.*

- (ii) *Ellipse*

- $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, e < 1, b^2 = a^2(1 - e^2)$

- $\frac{(x - \alpha)^2}{a^2} + \frac{(y - \beta)^2}{b^2} = 1$

- *Cases when  $a > b$  and  $a < b$ .*
- *Rough sketch of the above.*
- *Major axis, minor axis; latus rectum; coordinates of vertices, focus and centre; and equations of directrices and the axes.*
- *Finding equation of ellipse when focus and directrix are given.*
- *Simple and direct questions based on the above.*
- *Focal property i.e.  $SP + SP' = 2a$ .*

- (iii) *Hyperbola*

- $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, e > 1, b^2 = a^2(e^2 - 1)$

- $\frac{(x - \alpha)^2}{a^2} - \frac{(y - \beta)^2}{b^2} = 1$

- *Cases when coefficient  $y^2$  is negative and coefficient of  $x^2$  is negative.*

- *Rough sketch of the above.*

- *Focal property i.e.  $SP - S'P = 2a$ .*

- *Transverse and Conjugate axes; Latus rectum; coordinates of vertices, foci and centre; and equations of the directrices and the axes.*

- *General second-degree equation*  
 $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$

- *Case 1: pair of straight line if  $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$ ,*

- *Case 2:  $abc + 2fgh - af^2 - bg^2 - ch^2 \neq 0$ , then represents a parabola if  $h^2 = ab$ , ellipse if  $h^2 < ab$ , and hyperbola if  $h^2 > ab$ .*

- *Condition that  $y = mx + c$  is a tangent to the conics, general equation of tangents, point of contact and locus problems.*

### 7. Introduction to three-dimensional Geometry

Coordinate axes and coordinate planes in three dimensions. Coordinates of a point. Distance between two points and section formula.

- *As an extension of 2-D*

- *Distance formula.*

- *Section and midpoint form*

### 8. Mathematical Reasoning

Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to the Mathematics and real life. Validating the statements involving the connecting words, Difference between contradiction, converse and contrapositive.

*Self-explanatory.*

## SECTION C

### 9. Statistics

- Combined mean and standard deviation.
- The Median, Quartiles, Deciles, Percentiles and Mode of grouped and ungrouped data.

### 10. Correlation Analysis

- Definition and meaning of covariance.
- Coefficient of Correlation by Karl Pearson. If  $x - \bar{x}$ ,  $y - \bar{y}$  are small non-fractional numbers, we use

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sqrt{\sum(x - \bar{x})^2} \sqrt{\sum(y - \bar{y})^2}}$$

If  $x$  and  $y$  are small numbers, we use

$$r = \frac{\sum xy - \frac{1}{N} \sum x \sum y}{\sqrt{\sum x^2 - \frac{1}{N} (\sum x)^2} \sqrt{\sum y^2 - \frac{1}{N} (\sum y)^2}}$$

Otherwise, we use assumed means

$A$  and  $B$ , where  $u = x - A$ ,  $v = y - B$

$$r = \frac{\sum uv - \frac{1}{N} (\sum u)(\sum v)}{\sqrt{\sum u^2 - \frac{1}{N} (\sum u)^2} \sqrt{\sum v^2 - \frac{1}{N} (\sum v)^2}}$$

- Rank correlation by Spearman's (Correction included).

### 11. Index Numbers and Moving Averages

#### (i) Index Numbers

- Price index or price relative.
- Simple aggregate method.
- Weighted aggregate method.
- Simple average of price relatives.
- Weighted average of price relatives (cost of living index, consumer price index).

#### (ii) Moving Averages

- Meaning and purpose of the moving averages.

- Calculation of moving averages with the given periodicity and plotting them on a graph.
- If the period is even, then the centered moving average is to be found out and plotted.

## PAPER II – PROJECT WORK – 20 Marks

Candidates will be expected to have completed **two** projects, one from Section A and one from **either** Section B **or** Section C.

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks
<b>Total</b>	<b>10 marks</b>

**List of suggested assignments for Project Work:**

### Section A

1. Using a Venn diagram, find the number of subsets of a given set and verify that if a set has 'n' number of elements, the total number of subsets is  $2^n$ .
2. Verify that for two sets A and B,  $n(A \times B) = pq$ , where  $n(A) = p$  and  $n(B) = q$ , the total number of relations from A to B is  $2^{pq}$ .
3. Using Venn diagram, verify the distributive law for three given non-empty sets A, B and C.
4. Identify distinction between a relation and a function with suitable examples and illustrate graphically.
5. Establish the relationship between the measure of an angle in degrees and in radians with suitable examples by drawing a rough sketch.
6. Illustrate with the help of a model, the values of sine and cosine functions for different angles which are multiples of  $\pi/2$  and  $\pi$ .
7. Draw the graphs of  $\sin x$ ,  $\sin 2x$ ,  $2 \sin x$ , and  $\sin x/2$  on the same graph using same coordinate axes and interpret the same.

8. Draw the graph of  $\cos x$ ,  $\cos 2x$ ,  $2 \cos x$ , and  $\cos x/2$  on the same graph using same coordinate axes and interpret the same.
9. Using argand plane, interpret geometrically, the meaning of  $i = \sqrt{-1}$  and its integral powers.
10. Draw the graph of quadratic function  $f(x) = ax^2 + bx + c$ . From the graph find maximum/minimum value of the function. Also determine the sign of the expression.
11. Construct a Pascal's triangle to write a binomial expansion for a given positive integral exponent.
12. Obtain a formula for the sum of the squares/sum of cubes of 'n' natural numbers.
13. Obtain the equation of the straight line in the normal form, for  $\alpha$  (the angle between the perpendicular to the line from the origin and the x-axis) for each of the following, on the same graph:
  - (i)  $\alpha < 90^\circ$
  - (ii)  $90^\circ < \alpha < 180^\circ$
  - (iii)  $180^\circ < \alpha < 270^\circ$
  - (iv)  $270^\circ < \alpha < 360^\circ$
14. Identify the variability and consistency of two sets of statistical data using the concept of coefficient of variation.
15. Construct the tree structure of the outcomes of a random experiment, when elementary events are not equally likely. Also construct a sample space by taking a suitable example.
17. Use focal property of ellipse to construct ellipse.
18. Use focal property of hyperbola to construct hyperbola.
19. Write geometrical significance of X coordinate, Y coordinate, and Z coordinate in space. Using the above, find the distance of the point in space from x-axis/y-axis/z-axis. Explain the above using a three-dimensional model/ power point presentation.
20. Obtain truth values of compound statements of the type  $p \wedge q$  by using switch connection in series.
21. Obtain truth values of compound statements of the type  $p \vee q$  by using switch connection in parallel.

### Section C

22. Explain the statistical significance of percentile and draw inferences of percentile for a given data.
23. Find median from the point of intersection of cumulative frequency curves (less than and more than cumulative frequency curves).
24. Describe the limitations of Spearman's rank correlation coefficient and illustrate with suitable examples.
25. Identify the purchasing power using the concept of cost of living index number.
26. Identify the purchasing power using the concept of weighted aggregate price index number.
27. Calculate moving averages with the given even Periodicity. Plot them and as well as the original data on the same graph.
16. Construct different types of conics by PowerPoint Presentation, or by making a model, using the concept of double cone and a plane.

## CLASS XII

There will be **two** papers in the subject:

**Paper I** : Theory (3 hours) .....80 marks

**Paper II**: Project Work .....20 marks

### PAPER I (THEORY) – 80 Marks

The syllabus is divided into **three** sections A, B and C.

Section A is compulsory for all candidates. Candidates will have a choice of attempting questions from **EITHER** Section B **OR** Section C.

There will be one paper of **three** hours duration of 80 marks.

**Section A (65 Marks):** Candidates will be required to attempt **all** questions. Internal choice will be provided in two questions of two marks, two questions of four marks and two questions of six marks each.

**Section B/ Section C (15 Marks):** Candidates will be required to attempt **all** questions **EITHER** from Section B or Section C. Internal choice will be provided in one question of two marks and one question of four marks.

### DISTRIBUTION OF MARKS FOR THE THEORY PAPER

S.No.	UNIT	TOTAL WEIGHTAGE
<b>SECTION A: 65 MARKS</b>		
1.	Relations and Functions	10 Marks
2.	Algebra	10 Marks
3.	Calculus	32 Marks
4.	Probability	13 Marks
<b>SECTION B: 15 MARKS</b>		
5.	Vectors	5 Marks
6.	Three - Dimensional Geometry	6 Marks
7.	Applications of Integrals	4 Marks
<b>OR</b>		
<b>SECTION C: 15 MARKS</b>		
8.	Application of Calculus	5 Marks
9.	Linear Regression	6 Marks
10.	Linear Programming	4 Marks
<b>TOTAL</b>		<b>80 Marks</b>

## SECTION A

### 1. Relations and Functions

(i) Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, composite functions, inverse of a function. Binary operations.

- *Relations as:*
  - *Relation on a set A*
  - *Identity relation, empty relation, universal relation.*
  - *Types of Relations: reflexive, symmetric, transitive and equivalence relation.*
- *Binary Operation: all axioms and properties*
- *Functions:*
  - *As special relations, concept of writing “y is a function of x” as  $y = f(x)$ .*
  - *Types: one to one, many to one, into, onto.*
  - *Real Valued function.*
  - *Domain and range of a function.*
  - *Conditions of invertibility.*
  - *Composite functions and invertible functions (algebraic functions only).*

(ii) Inverse Trigonometric Functions

Definition, domain, range, principal value branch. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

- *Principal values.*
- *$\sin^{-1}x, \cos^{-1}x, \tan^{-1}x$  etc. and their graphs.*
- *$\sin^{-1}x = \cos^{-1}\sqrt{1-x^2} = \tan^{-1}\frac{x}{\sqrt{1-x^2}}$ .*
- *$\sin^{-1}x = \operatorname{cosec}^{-1}\frac{1}{x}$ ;  $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$  and similar relations for  $\cot^{-1}x, \tan^{-1}x$ , etc.*

$$\sin^{-1}x \pm \sin^{-1}y = \sin^{-1}\left(x\sqrt{1-y^2} \pm y\sqrt{1-x^2}\right)$$

$$\cos^{-1}x \pm \cos^{-1}y = \cos^{-1}\left(xy \mp \sqrt{1-y^2}\sqrt{1-x^2}\right)$$

$$\text{similarly } \tan^{-1}x + \tan^{-1}y = \tan^{-1}\frac{x+y}{1-xy}, xy < 1$$

$$\tan^{-1}x - \tan^{-1}y = \tan^{-1}\frac{x-y}{1+xy}, xy > -1$$

- *Formulae for  $2\sin^{-1}x, 2\cos^{-1}x, 2\tan^{-1}x, 3\tan^{-1}x$  etc. and application of these formulae.*

### 2. Algebra

Matrices and Determinants

(i) Matrices

Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication. Non-commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix (restrict to square matrices of order upto 3). Concept of elementary row and column operations. Invertible matrices and proof of the uniqueness of inverse, if it exists (here all matrices will have real entries).

(ii) Determinants

Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

- *Types of matrices ( $m \times n$ ;  $m, n \leq 3$ ), order; Identity matrix, Diagonal matrix.*
- *Symmetric, Skew symmetric.*

- Operation – addition, subtraction, multiplication of a matrix with scalar, multiplication of two matrices (the compatibility).

E.g.  $\begin{bmatrix} 1 & 1 \\ 0 & 2 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix} = AB(\text{say})$  but  $BA$  is

not possible.

- Singular and non-singular matrices.
- Existence of two non-zero matrices whose product is a zero matrix.

- Inverse ( $2 \times 2, 3 \times 3$ )  $A^{-1} = \frac{\text{Adj}A}{|A|}$

- Martin's Rule (i.e. using matrices)

$$a_1x + b_1y + c_1z = d_1$$

$$a_2x + b_2y + c_2z = d_2$$

$$a_3x + b_3y + c_3z = d_3$$

$$A = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix} \quad B = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \quad X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$AX = B \Rightarrow X = A^{-1}B$$

Problems based on above.

**NOTE 1:** The conditions for consistency of equations in two and three variables, using matrices, are to be covered.

**NOTE 2:** Inverse of a matrix by elementary operations to be covered.

- Determinants
  - Order.
  - Minors.
  - Cofactors.
  - Expansion.
  - Applications of determinants in finding the area of triangle and collinearity.
  - Properties of determinants. Problems based on properties of determinants.

### 3. Calculus

- (i) Continuity, Differentiability and Differentiation. Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions. Concept of exponential and logarithmic functions.

Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation.

- Continuity

- Continuity of a function at a point  $x = a$ .
- Continuity of a function in an interval.
- Algebra of continuous function.
- Removable discontinuity.

- Differentiation

- Concept of continuity and differentiability of  $|x|$ ,  $[x]$ , etc.
- Derivatives of trigonometric functions.
- Derivatives of exponential functions.
- Derivatives of logarithmic functions.
- Derivatives of inverse trigonometric functions - differentiation by means of substitution.
- Derivatives of implicit functions and chain rule.
- $e$  for composite functions.
- Derivatives of Parametric functions.
- Differentiation of a function with respect to another function e.g. differentiation of  $\sin x^3$  with respect to  $x^3$ .
- Logarithmic Differentiation - Finding  $dy/dx$  when  $y = x^{x^{x^{\dots}}}$ .
- Successive differentiation up to 2<sup>nd</sup> order.

**NOTE 1:** Derivatives of composite functions using chain rule.

**NOTE 2:** Derivatives of determinants to be covered.

- *L' Hospital's theorem.*
  - $\frac{0}{0}$  form,  $\frac{\infty}{\infty}$  form,  $0^0$  form,  $\infty^\infty$  form etc.
- *Rolle's Mean Value Theorem - its geometrical interpretation.*
- *Lagrange's Mean Value Theorem - its geometrical interpretation*

(ii) Applications of Derivatives

Applications of derivatives: rate of change of bodies, increasing/decreasing functions, tangents and normals, use of derivatives in approximation, maxima and minima (first derivative test motivated geometrically and second derivative test given as a provable tool). Simple problems (that illustrate basic principles and understanding of the subject as well as real-lifesituations).

- *Equation of Tangent and Normal*
- *Approximation.*
- *Rate measure.*
- *Increasing and decreasing functions.*
- *Maxima and minima.*
  - *Stationary/turning points.*
  - *Absolute maxima/minima*
  - *local maxima/minima*
  - *First derivatives test and second derivatives test*
  - *Point of inflexion.*
  - *Application problems based on maxima and minima.*

(iii) Integrals

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems based on them.

Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

- *Indefinite integral*
  - *Integration as the inverse of differentiation.*
  - *Anti-derivatives of polynomials and functions  $(ax + b)^n$ ,  $\sin x$ ,  $\cos x$ ,  $\sec^2 x$ ,  $\operatorname{cosec}^2 x$  etc .*
  - *Integrals of the type  $\sin^2 x$ ,  $\sin^3 x$ ,  $\sin^4 x$ ,  $\cos^2 x$ ,  $\cos^3 x$ ,  $\cos^4 x$ .*
  - *Integration of  $1/x$ ,  $e^x$ .*
  - *Integration by substitution.*
  - *Integrals of the type  $f'(x)[f(x)]^n$ ,  $\frac{f'(x)}{f(x)}$ .*
  - *Integration of  $\tan x$ ,  $\cot x$ ,  $\sec x$ ,  $\operatorname{cosec} x$ .*
  - *Integration by parts.*
  - *Integration using partial fractions. Expressions of the form  $\frac{f(x)}{g(x)}$  when degree of  $f(x) <$  degree of  $g(x)$*

E.g. 
$$\frac{x+2}{(x-3)(x+1)} = \frac{A}{x-3} + \frac{B}{x+1}$$

$$\frac{x+2}{(x-2)(x-1)^2} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x-2}$$

$$\frac{x+1}{(x^2+3)(x-1)} = \frac{Ax+B}{x^2+3} + \frac{C}{x-1}$$

When degree of  $f(x) \geq$  degree of  $g(x)$ ,

e.g. 
$$\frac{x^2+1}{x^2+3x+2} = 1 - \left( \frac{3x+1}{x^2+3x+2} \right)$$

- *Integrals of the type:*

$$\int \frac{dx}{x^2 \pm a^2}, \int \frac{dx}{\sqrt{x^2 \pm a^2}}, \int \frac{px+q}{ax^2+bx+c} dx, \int \frac{px+q}{\sqrt{ax^2+bx+c}} dx$$
and 
$$\int \sqrt{a^2 \pm x^2} dx, \int \sqrt{x^2 - a^2} dx,$$

$\int \sqrt{ax^2 + bx + c} dx, \int (px + q)\sqrt{ax^2 + bx + c} dx,$   
 integrations reducible to the above forms.

$$\int \frac{dx}{a \cos x + b \sin x},$$

$$\int \frac{dx}{a + b \cos x}, \int \frac{dx}{a + b \sin x}, \int \frac{dx}{a \cos x + b \sin x + c},$$

$$\int \frac{(a \cos x + b \sin x) dx}{c \cos x + d \sin x},$$

$$\int \frac{dx}{a \cos^2 x + b \sin^2 x + c}$$

$$\int \frac{1 \pm x^2}{1 + x^4} dx,$$

$$\int \frac{dx}{1 + x^4}, \int \sqrt{\tan x} dx, \int \sqrt{\cot x} dx \text{ etc.}$$

• **Definite Integral**

- Definite integral as a limit of the sum.
- Fundamental theorem of calculus (without proof)
- Properties of definite integrals.
- Problems based on the following properties of definite integrals are to be covered.

$$\int_a^b f(x) dx = \int_a^b f(t) dt$$

$$\int_a^b f(x) dx = - \int_b^a f(x) dx$$

$$\int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx$$

where  $a < c < b$

$$\int_a^b f(x) dx = \int_a^b f(a + b - x) dx$$

$$\int_0^a f(x) dx = \int_0^a f(a - x) dx$$

$$\int_0^{2a} f(x) dx = \begin{cases} 2 \int_0^a f(x) dx, & \text{if } f(2a - x) = f(x) \\ 0, & \text{if } f(2a - x) = -f(x) \end{cases}$$

$$\int_{-a}^a f(x) dx = \begin{cases} 2 \int_0^a f(x) dx, & \text{if } f \text{ is an even function} \\ 0, & \text{if } f \text{ is an odd function} \end{cases}$$

(iv) **Differential Equations**

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables solutions of homogeneous differential equations of first order and first degree. Solutions of linear differential equation of the type:  $\frac{dy}{dx} + py = q,$

where p and q are functions of x or constants.  $\frac{dx}{dy} + px = q,$  where p and q are functions of y or constants.

- Differential equations, order and degree.
- Formation of differential equation by eliminating arbitrary constant(s).
- Solution of differential equations.
- Variable separable.
- Homogeneous equations.
- Linear form  $\frac{dy}{dx} + Py = Q$  where P and Q are functions of x only. Similarly, for dx/dy.
- Solve problems of application on growth and decay.
- Solve problems on velocity, acceleration, distance and time.
- Solve population-based problems on application of differential equations.
- Solve problems of application on coordinate geometry.

**NOTE 1:** Equations reducible to variable separable type are included.

**NOTE 2:** The second order differential equations are excluded.



#### 4. Probability

Conditional probability, multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution, mean and variance of random variable. Repeated independent (Bernoulli) trials and Binomial distribution.

- *Independent and dependent events conditional events.*
- *Laws of Probability, addition theorem, multiplication theorem, conditional probability.*
- *Theorem of Total Probability.*
- *Baye's theorem.*
- *Theoretical probability distribution, probability distribution function; mean and variance of random variable, Repeated independent (Bernoulli trials), binomial distribution – its mean and variance.*

### SECTION B

#### 5. Vectors

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors, scalar triple product of vectors.

- *As directed line segments.*
- *Magnitude and direction of a vector.*
- *Types: equal vectors, unit vectors, zero vector.*
- *Position vector.*
- *Components of a vector.*
- *Vectors in two and three dimensions.*

- *$\hat{i}$ ,  $\hat{j}$ ,  $\hat{k}$  as unit vectors along the x, y and the z axes; expressing a vector in terms of the unit vectors.*
- *Operations: Sum and Difference of vectors; scalar multiplication of a vector.*
- *Section formula.*
- *Triangle inequalities.*
- *Scalar (dot) product of vectors and its geometrical significance.*
- *Cross product - its properties - area of a triangle, area of parallelogram, collinear vectors.*
- *Scalar triple product - volume of a parallelepiped, co-planarity.*

**NOTE: Proofs of geometrical theorems by using Vector algebra are excluded.**

#### 6. Three - dimensional Geometry

Direction cosines and direction ratios of a line joining two points. Cartesian equation and vector equation of a line, coplanar and skew lines, shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a point from a plane.

- *Equation of x-axis, y-axis, z axis and lines parallel to them.*
- *Equation of xy - plane, yz - plane, zx - plane.*
- *Direction cosines, direction ratios.*
- *Angle between two lines in terms of direction cosines /direction ratios.*
- *Condition for lines to be perpendicular/parallel.*
- *Lines*
  - *Cartesian and vector equations of a line through one and two points.*
  - *Coplanar and skew lines.*
  - *Conditions for intersection of two lines.*
  - *Distance of a point from a line.*
  - *Shortest distance between two lines.*

**NOTE: Symmetric and non-symmetric forms of lines are required to be covered.**

- *Planes*
  - *Cartesian and vector equation of a plane.*
  - *Direction ratios of the normal to the plane.*
  - *One point form.*
  - *Normal form.*
  - *Intercept form.*
  - *Distance of a point from a plane.*
  - *Intersection of the line and plane.*
  - *Angle between two planes, a line and a plane.*
  - *Equation of a plane through the intersection of two planes i.e.  $P_1 + kP_2 = 0$ .*

## 7. Application of Integrals

Application in finding the area bounded by simple curves and coordinate axes. Area enclosed between two curves.

- *Application of definite integrals - area bounded by curves, lines and coordinate axes is required to be covered.*
- *Simple curves: lines, circles/ parabolas/ ellipses, polynomial functions, modulus function, trigonometric function, exponential functions, logarithmic functions*

## SECTION C

## 8. Application of Calculus

Application of Calculus in Commerce and Economics in the following:

- Cost function,
- average cost,
- marginal cost and its interpretation
- demand function,
- revenue function,
- marginal revenue function and its interpretation,
- Profit function and breakeven point.
- Rough sketching of the following curves: AR, MR, R, C, AC, MC and their

mathematical interpretation using the concept of maxima & minima and increasing- decreasing functions.

*Self-explanatory*

**NOTE: Application involving differentiation, integration, increasing and decreasing function and maxima and minima to be covered.**

## 9. Linear Regression

- Lines of regression of x on y and y on x.
- Scatter diagrams
- The method of least squares.
- Lines of best fit.
- Regression coefficient of x on y and y on x.
- $b_{xy} \times b_{yx} = r^2$ ,  $0 \leq b_{xy} \times b_{yx} \leq 1$
- Identification of regression equations
- Angle between regression line and properties of regression lines.
- Estimation of the value of one variable using the value of other variable from appropriate line of regression.

*Self-explanatory*

## 10. Linear Programming

Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded and unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

*Introduction, definition of related terminology such as constraints, objective function, optimization, advantages of linear programming; limitations of linear programming; application areas of linear programming; different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimum feasible solution.*

## **PAPER II – PROJECT WORK – 20 Marks**

Candidates will be expected to have completed two projects, one from Section A and one from either Section B or Section C.

**The project work will be assessed by the subject teacher and a Visiting Examiner appointed locally and approved by the Council.**

Mark allocation for **each** Project [10 marks]:

Overall format	1 mark
Content	4 marks
Findings	2 marks
Viva-voce based on the Project	3 marks
<b>Total</b>	<b>10 marks</b>

### **List of suggested assignments for Project Work:**

#### **Section A**

- Using a graph, demonstrate a function which is one-one but not onto.
- Using a graph demonstrate a function which is invertible.
- Construct a composition table using a binary function addition/multiplication modulo upto 5 and verify the existence of the properties of binary operation.
- Draw the graph of  $y = \sin^{-1} x$  (or any other inverse trigonometric function), using the graph of  $y = \sin x$  (or any other relevant trigonometric function). Demonstrate the concept of mirror line (about  $y = x$ ) and find its domain and range.
- Explore the principal value of the function  $\sin^{-1} x$  (or any other inverse trigonometric function) using a unit circle.
- Find the derivatives of a determinant of the order of  $3 \times 3$  and verify the same by other methods.
- Verify the consistency of the system of three linear equations of two variables and verify the same graphically. Give its geometrical interpretation.
- For a dependent system (non-homogeneous) of three linear equations of three variables, identify infinite number of solutions.
- For a given function, give the geometrical interpretation of Mean Value theorems. Explain the significance of closed and open intervals for continuity and differentiability properties of the theorems.
- Explain the concepts of increasing and decreasing functions, using geometrical significance of  $dy/dx$ . Illustrate with proper examples.
- Explain the geometrical significance of point of inflexion with examples and illustrate it using graphs.
- Explain and illustrate (with suitable examples) the concept of local maxima and local minima using graph.
- Explain and illustrate (with suitable examples) the concept of absolute maxima and absolute minima using graph.
- Illustrate the concept of definite integral  $\int_a^b f(x) dx$ , expressing as the limit of a sum and verify it by actual integration.
- Demonstrate application of differential equations to solve a given problem (example, population increase or decrease, bacteria count in a culture, etc.).
- Explain the conditional probability, the theorem of total probability and the concept of Bayes' theorem with suitable examples.
- Explain the types of probability distributions and derive mean and variance of binomial probability distribution for a given function.

#### **Section B**

- Using vector algebra, find the area of a parallelogram/triangle. Also, derive the area analytically and verify the same.
- Using Vector algebra, prove the formulae of properties of triangles (sine/cosine rule, etc.)
- Using Vector algebra, prove the formulae of compound angles, e.g.  $\sin(A + B) = \sin A \cos B + \sin B \cos A$ , etc.

21. Describe the geometrical interpretation of scalar triple product and for a given data, find the scalar triple product.
22. Find the image of a line with respect to a given plane.
23. Find the distance of a point from a given plane measured parallel to a given line.
24. Find the distance of a point from a line measured parallel to a given plane.
25. Find the area bounded by a parabola and an oblique line.
26. Find the area bounded by a circle and an oblique line.
27. Find the area bounded by an ellipse and an oblique line.
28. Find the area bounded by a circle and a circle.
29. Find the area bounded by a parabola and a parabola.
30. Find the area bounded by a circle and a parabola.

**(Any other pair of curves which are specified in the syllabus may also be taken.)**

### Section C

31. Draw a rough sketch of Cost (C), Average Cost (AC) and Marginal Cost (MC)

Or

Revenue (R), Average Revenue (AR) and Marginal Revenue (MR).

Give their mathematical interpretation using the concept of increasing - decreasing functions and maxima-minima.

32. For a given data, find regression equations by the method of least squares. Also find angles between regression lines.
33. Draw the scatter diagram for a given data. Use it to draw the lines of best fit and estimate the value of Y when X is given and vice-versa.
34. Using any suitable data, find the minimum cost by applying the concept of Transportation problem.
35. Using any suitable data, find the minimum cost and maximum nutritional value by applying the concept of Diet problem.
36. Using any suitable data, find the Optimum cost in the manufacturing problem by formulating a linear programming problem (LPP).

**NOTE:** No question paper for Project Work will be set by the Council.

### SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	<u>PROJECT 1</u>					<u>PROJECT 2</u>					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)	(E + J)
		7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	7 Marks*	7 Marks*	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

*Breakup of 7 Marks to be awarded separately by the Teacher and the Visiting Examiner is as follows:		Name of Teacher:	
Overall Format	1 Mark	Signature:	Date
Content	4 Marks	Name of Visiting Examiner	
Findings	2 Marks	Signature:	Date

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner, and should be based on the Project only**

## PHYSICS (861)

### Aims:

1. To enable candidates to acquire knowledge and to develop an understanding of the terms, facts, concepts, definitions, and fundamental laws, principles and processes in the field of physics.
2. To develop the ability to apply the knowledge and understanding of physics to unfamiliar situations.
3. To develop a scientific attitude through the study of physical sciences.
4. To develop skills in -
  - (a) the practical aspects of handling apparatus, recording observations and
  - (b) Drawing diagrams, graphs, etc.
5. To develop an appreciation of the contribution of physics towards scientific and technological developments and towards human happiness.
6. To develop an interest in the world of physical sciences.

### CLASS XI

*There will be two papers in the subject:*

**Paper I: Theory** - 3 hours ... 70 marks

**Paper II: Practical** - 3 hours ... 15 marks

Project Work ... 10 marks

Practical File ... 5 marks

### PAPER I- THEORY: 70 Marks

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

S. NO.	UNIT	TOTAL WEIGHTAGE
1.	Physical World and Measurement	23 Marks
2.	Kinematics	
3.	Laws of Motion	
4.	Work, Energy and Power	17 Marks
5.	Motion of System of Particles and Rigid Body	
6.	Gravitation	
7.	Properties of Bulk Matter	20 Marks
8.	Heat and Thermodynamics	
9.	Behaviour of Perfect Gases and Kinetic Theory of Gases	
10.	Oscillations and Waves	10 Marks
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I -THEORY – 70 MARKS

**Note:** (i) Unless otherwise specified, only S. I. Units are to be used while teaching and learning, as well as for answering questions.

(ii) All physical quantities to be defined as and when they are introduced along with their units and dimensions.

(iii) Numerical problems are included from all topics except where they are specifically excluded or where only qualitative treatment is required.

### 1. Physical World and Measurement

#### (i) Physical World:

Scope of Physics and its application in everyday life. Nature of physical laws.

*Physics and its branches (only basic knowledge required); fundamental laws and fundamental forces in nature (gravitational force, electro-magnetic force, strong and weak nuclear forces; unification of forces). Application of Physics in technology and society (major scientists, their discoveries, inventions and laws/principles to be discussed briefly).*

#### (ii) Units and Measurements

Measurement: need for measurement; units of measurement; systems of units: fundamental and derived units in SI; measurement of length, mass and time; accuracy and precision of measuring instruments; errors in measurement; significant figures.

Dimensional formulae of physical quantities and constants, dimensional analysis and its applications.

(a) *Importance of measurement in scientific studies; physics is a science of measurement. Unit as a reference standard of measurement; essential properties. Systems of units; CGS, FPS, MKS, MKSA, and SI; the seven base units of SI selected by the General Conference of Weights and Measures in 1971 and their definitions, list of fundamental, supplementary and derived physical quantities; their units and symbols (strictly as per rule); subunits and multiple units using prefixes for powers of 10 (from atto for  $10^{-18}$  to tera*

*for  $10^{12}$ ); other common units such as fermi, angstrom (now outdated), light year, astronomical unit and parsec. A new unit of mass used in atomic physics is unified atomic mass unit with symbol u (not amu); rules for writing the names of units and their symbols in SI (upper case/lower case.) Derived units (with correct symbols); special names wherever applicable; expression in terms of base units (e.g.:  $N = \text{kg m/s}^2$ ).*

- (b) *Accuracy of measurement, errors in measurement: precision of measuring instruments, instrumental errors, systematic errors, random errors and gross errors. Least count of an instrument and its implication on errors in measurements; absolute error, relative error and percentage error; combination of errors in (a) sum and difference, (b) product and quotient and (c) power of a measured quantity.*
- (c) *Significant figures; their significance; rules for counting the number of significant figures; rules for (a) addition and subtraction, (b) multiplication/division; ‘rounding off’ the uncertain digits; order of magnitude as statement of magnitudes in powers of 10; examples from magnitudes of common physical quantities - size, mass, time, etc.*
- (d) *Dimensions of physical quantities; dimensional formula; express derived units in terms of base units ( $N = \text{kg.m s}^{-2}$ ); use symbol [...] for dimensions of or base unit of; e.g.: dimensional formula of force in terms of fundamental quantities written as  $[F] = [MLT^{-2}]$ . Principle of homogeneity of dimensions. Expressions in terms of SI base units and dimensional formula may be obtained for all physical quantities as and when new physical quantities are introduced.*
- (e) *Use of dimensional analysis to (i) check the dimensional correctness of a formula/ equation; (ii) to obtain the dimensional formula of any derived physical quantity including constants; (iii) to convert units from one system to another; limitations of dimensional analysis.*

## 2. Kinematics

### (i) Motion in a Straight Line

Frame of references, Motion in a straight line (one dimension): Position-time graph, speed and velocity.

Elementary concepts of differentiation and integration for describing motion, uniform and non-uniform motion, average speed, velocity, average velocity, instantaneous velocity and uniformly accelerated motion, velocity - time and position - time graphs. Relations for uniformly accelerated motion (graphical treatment).

*Frame of reference, concept of point mass, rest and motion; distance and displacement, speed and velocity, average speed and average velocity, uniform velocity, instantaneous speed and instantaneous velocity, acceleration, instantaneous acceleration, s-t, v-t and a-t graphs for uniform acceleration and conclusions drawn from these graphs; kinematic equations of motion for objects in uniformly accelerated rectilinear motion derived using graphical, calculus or analytical method, motion of an object under gravity, (one dimensional motion).*

*Differentiation as rate of change; examples from physics – speed, acceleration, velocity gradient, etc. Formulae for differentiation of simple functions:  $x^n$ ,  $\sin x$ ,  $\cos x$ ,  $e^x$  and  $\ln x$ . Simple ideas about integration – mainly,  $\int x^n dx$ . Both definite and indefinite integrals to be mentioned (elementary calculus not to be evaluated).*

### (ii) Motion in a Plane

Scalar and Vector quantities with examples. Position and displacement vectors, general vectors and their notations; equality of vectors, addition and subtraction of vectors, relative velocity, Unit vector; resolution of a vector in a plane, rectangular components, Scalar and Vector product of two vectors. Projectile motion and uniform circular motion.

(a) *General Vectors and notation, position and displacement vector. Vectors explained using displacement as a*

*prototype - along a straight line (one dimensional), on a plane surface (two dimensional) and in an open space not confined to a line or a plane (three dimensional); symbol and representation; a scalar quantity, its representation and unit, equality of vectors. Unit vectors denoted by  $\hat{i}$ ,  $\hat{j}$ ,  $\hat{k}$  orthogonal unit vectors along x, y and z axes respectively. Examples of one dimensional vector  $\vec{V}_1 = a\hat{i}$  or  $b\hat{j}$  or  $c\hat{k}$  where a, b, c are scalar quantities or numbers;  $\vec{V}_2 = a\hat{i} + b\hat{j}$  is a two dimensional or planar vector,  $\vec{V}_3 = a\hat{i} + b\hat{j} + c\hat{k}$  is a three dimensional or space vector. Concept of null vector and coplanar vectors.*

(b) *Addition: use displacement as an example; obtain triangle law of addition; graphical and analytical treatment; Discuss commutative and associative properties of vector addition (Proof not required). Parallelogram Law; sum and difference; derive expressions for magnitude and direction from parallelogram law; special cases; subtraction as special case of addition with direction reversed; use of Triangle Law for subtraction also; if  $\vec{a} + \vec{b} = \vec{c}$ ;  $\vec{c} - \vec{a} = \vec{b}$ ; In a parallelogram, if one diagonal is the sum, the other diagonal is the difference; addition and subtraction with vectors expressed in terms of unit vectors  $\hat{i}$ ,  $\hat{j}$ ,  $\hat{k}$ ; multiplication of a vector by a real number.*

(c) *Use triangle law of addition to express a vector in terms of its components. If  $\vec{a} + \vec{b} = \vec{c}$  is an addition fact,  $\vec{c} = \vec{a} + \vec{b}$  is a resolution;  $\vec{a}$  and  $\vec{b}$  are components of  $\vec{c}$ . Rectangular components, resultant and angle between them. Dot (or scalar) product of vectors  $\vec{a} \cdot \vec{b} = ab \cos \theta$ ;*



example  $W = \vec{F} \cdot \vec{S} = FS \cos\theta$ . Special case of  $\theta = 0^\circ, 90^\circ$  and  $180^\circ$ . Vector (or cross) product  $\vec{a} \times \vec{b} = [ab \sin\theta] \hat{n}$ ; example: torque  $\vec{\tau} = \vec{r} \times \vec{F}$ ; Special cases using unit vectors  $\hat{i}, \hat{j}, \hat{k}$  for  $\vec{a} \cdot \vec{b}$  and  $\vec{a} \times \vec{b}$ .

- (d) Concept of relative velocity, start from simple examples on relative velocity of one dimensional motion and then two dimensional motion; consider displacement first; relative displacement (use Triangle Law or parallelogram Law).
- (e) Various terms related to projectile motion; obtain equations of trajectory, time of flight, maximum height, horizontal range, instantaneous velocity, [projectile motion on an inclined plane not included]. Examples of projectile motion.
- (f) Examples of uniform circular motion: details to be covered in unit 3 (d).

### 3. Laws of Motion

General concept of force, inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion.

Law of conservation of linear momentum and its applications.

Equilibrium of concurrent forces. Friction: Static and kinetic friction, laws of friction, rolling friction, lubrication.

Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on a level circular road, vehicle on a banked road).

- (a) Newton's first law: Statement and explanation; concept of inertia, mass, force; law of inertia; mathematically, if  $\Sigma F=0$ ,  $a=0$ .

Newton's second law:  $\vec{p} = m\vec{v}$ ;  $\vec{F} \propto \frac{d\vec{p}}{dt}$ ;

$\vec{F} = k \frac{d\vec{p}}{dt}$ . Define unit of force so that  $k=1$ ;

$\vec{F} = \frac{d\vec{p}}{dt}$ ; a vector equation. For classical

physics with  $v$  not large and mass  $m$  remaining constant, obtain  $\vec{F} = m\vec{a}$ . For  $v \rightarrow c$ ,  $m$  is not constant. Then  $m = \frac{m_0}{\sqrt{1-v^2/c^2}}$  Note that  $F = ma$  is the

special case for classical mechanics. It is a vector equation.  $\vec{a} \parallel \vec{F}$ . Also, this can be resolved into three scalar equations  $F_x = ma_x$  etc. Application to numerical problems; introduce tension force, normal reaction force. If  $a = 0$  (body in equilibrium),  $F = 0$ . Statement, derivation and explanation of principle of conservation of linear momentum. Impulse of a force:  $F\Delta t = \Delta p$ .

Newton's third law. Obtain it using Law of Conservation of linear momentum. Proof of Newton's second law as real law. Systematic solution of problems in mechanics; isolate a part of a system, identify all forces acting on it; draw a free body diagram representing the part as a point and representing all forces by line segments, solve for resultant force which is equal to  $m\vec{a}$ . Simple problems on "Connected bodies" (not involving two pulleys).

- (b) Force diagrams; resultant or net force from Triangle law of Forces, parallelogram law or resolution of forces. Apply net force  $\Sigma \vec{F} = m\vec{a}$ . Again for equilibrium  $a=0$  and  $\Sigma F=0$ . Conditions of equilibrium of a rigid body under three coplanar forces. Discuss ladder problem.
- (c) Friction; classical view and modern view of friction, static friction a self-adjusting force; limiting value; kinetic friction or sliding friction; rolling friction, examples.

Laws of friction: Two laws of static friction; (similar) two laws of kinetic friction; coefficient of friction  $\mu_s = f_s(\max)/N$  and  $\mu_k = f_k/N$ ; graphs. Friction as a non-conservative force; motion under friction, net force in Newton's 2<sup>nd</sup> law is calculated including  $f_k$ . Motion along a rough inclined plane – both up and down. Pulling and pushing of a roller. Angle of friction and angle of repose. Lubrication, use of bearings, streamlining, etc.

(d) Angular displacement ( $\theta$ ), angular velocity ( $\omega$ ), angular acceleration ( $\alpha$ ) and their relations. Concept of centripetal acceleration; obtain an expression for this acceleration using  $\Delta\vec{v}$ . Magnitude and direction of  $\vec{a}$  same as that of  $\Delta\vec{v}$ ; Centripetal acceleration; the cause of this acceleration is a force - also called centripetal force; the name only indicates its direction, it is not a new type of force, motion in a vertical circle; banking of road and railway track (conical pendulum is excluded).

#### 4. Work, Power and Energy

Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power.

Potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); Conservative and non-conservative forces. Concept of collision: elastic and inelastic collisions in one and two dimensions.

(i) Work done  $W = \vec{F} \cdot \vec{S} = FS\cos\theta$ . If  $F$  is variable  $dW = \vec{F} \cdot d\vec{S}$  and  $W = \int dW = \int \vec{F} \cdot d\vec{S}$ , for  $\vec{F} \parallel d\vec{S}$   $\vec{F} \cdot d\vec{S} = FdS$  therefore,  $W = \int FdS$  is the area under the  $F$ - $S$  graph or if  $F$  can be expressed in terms of  $S$ ,  $\int FdS$  can be evaluated. Example, work done in stretching a spring  $W = \int Fdx = \int kxdx = \frac{1}{2}kx^2$ . This is also the potential energy stored in the stretched spring  $U = \frac{1}{2}kx^2$ .

Kinetic energy and its expression, Work-Energy theorem  $E=W$ . Law of Conservation of Energy; oscillating spring.  $U+K = E = K_{max} = U_{max}$  (for  $U = 0$  and  $K = 0$  respectively); graph different forms of energy and their transformations.  $E = mc^2$  (no derivation). Power  $P=W/t$ ;  $P = \vec{F} \cdot \vec{v}$ .

(ii) Collision in one dimension; derivation of velocity equation for general case of  $m_1 \neq m_2$  and  $u_1 \neq u_2 \neq 0$ ; Special cases for  $m_1 = m_2 = m$ ;  $m_1 \gg m_2$  or  $m_1 \ll m_2$ . Oblique collisions i.e. collision in two dimensions.

#### 5. Motion of System of Particles and Rigid Body

Idea of centre of mass: centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of a rigid body; centre of mass of a uniform rod.

Moment of a force, torque, angular momentum, laws of conservation of angular momentum and its applications.

Equilibrium of rigid bodies, rigid body rotation and equations of rotational motion, comparative study of linear and rotational motions.

Moment of inertia, radius of gyration, moments of inertia for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications.

(i) Definition of centre of mass ( $cm$ ), centre of mass ( $cm$ ) for a two particle system  $m_1x_1 + m_2x_2 = Mx_{cm}$ ; differentiating, get the equation for  $v_{cm}$  and  $a_{cm}$ ; general equation for  $N$  particles- many particles system; [need not go into more details]; centre of gravity, principle of moment, discuss ladder problem, concept of a rigid body; kinetic energy of a rigid body rotating about a fixed axis in terms of that of the particles of the body; hence, define moment of inertia and radius of gyration; physical significance of moment of inertia; unit and dimension; depends on mass and axis of rotation; it is rotational inertia; equations of rotational motions. Applications: only expression for the moment of inertia,  $I$  (about the symmetry axis) of: (i) a ring; (ii) a solid and a hollow cylinder, (iii) a thin rod (iv) a solid and a hollow sphere, (v) a disc - only formulae (no derivations required).

(a) Statements of the parallel and perpendicular axes theorems with illustrations [derivation not required]. Simple examples with change of axis.

(b) Definition of torque (vector);  $\vec{\tau} = \vec{r} \times \vec{F}$  and angular momentum  $\vec{L} = \vec{r} \times \vec{p}$  for a particle (no derivations); differentiate to obtain  $d\vec{L}/dt = \vec{\tau}$ ; similar to Newton's second law of motion (linear); hence  $\tau = I\alpha$  and  $L = I\omega$ ; (only scalar equation); Law of conservation of angular momentum; simple applications. Comparison of linear and rotational motions.

## 6. Gravitation

Kepler's laws of planetary motion, universal law of gravitation. Acceleration due to gravity ( $g$ ) and its variation with altitude, latitude and depth.

Gravitational potential and gravitational potential energy, escape velocity, orbital velocity of a satellite, Geo-stationary satellites.

(i) *Newton's law of universal gravitation; Statement; unit and dimensional formula of universal gravitational constant,  $G$  [Cavendish experiment not required]; gravitational acceleration on surface of the earth ( $g$ ), weight of a body  $W = mg$  from  $F = ma$ .*

(ii) *Relation between  $g$  and  $G$ . Derive the expression for variation of  $g$  above and below the surface of the earth; graph; mention variation of  $g$  with latitude and rotation, (without derivation).*

(iii) *Gravitational field, intensity of gravitational field and potential at a point in earth's gravitational field.  $V_p = W_{cp}/m$ . Derive expression (by integration) for the gravitational potential difference  $\Delta V = V_B - V_A = G.M(1/r_A - 1/r_B)$ ; here  $V_p = V(r) = -GM/r$ ; negative sign for attractive force field; define gravitational potential energy of a mass  $m$  in the earth's field; expression for gravitational potential energy  $U(r) = W_{cp} = m.V(r) = -G M m/r$ ; show that  $\Delta U = mgh$ , for  $h \ll R$ . Relation between intensity and acceleration due to gravity.*

(iv) *Derive expression for the escape velocity of earth using energy consideration;  $v_e$  depends on mass of the earth; for moon  $v_e$  is less as mass of moon is less; consequence - no atmosphere on the moon.*

(v) *Satellites (both natural (moon) and artificial) in uniform circular motion around the earth; Derive the expression for orbital velocity and time period; note the centripetal acceleration is caused (or centripetal force is provided) by the force of gravity exerted by the earth on the satellite; the acceleration of the satellite is the acceleration due to gravity [ $g' = g(R/R+h)^2$ ;  $F'_G = mg'$ ].*

*Weightlessness; geostationary satellites; conditions for satellite to be geostationary; parking orbit, calculation of its radius and height; basic concept of polar satellites and their uses.*

(vi) *Kepler's laws of planetary motion: explain the three laws using diagrams. Proof of third law (for circular orbits only).*

## 7. Properties of Bulk Matter

(i) *Mechanical Properties of Solids: Elastic behaviour of solids, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity, Poisson's ratio; elastic energy.*

*Elasticity in solids, Hooke's law, Young modulus and its determination, bulk modulus and shear modulus of rigidity, work done in stretching a wire and strain energy, Poisson's ratio.*

(ii) *Mechanical Properties of Fluids*

*Pressure due to a fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes), effect of gravity on fluid pressure.*

*Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its applications.*

*Surface energy and surface tension, angle of contact, excess of pressure across a curved surface, application of surface tension ideas to drops, bubbles and capillary rise.*

(a) *Pressure in a fluid, Pascal's Law and its applications, buoyancy (Archimedes Principle).*

(b) *General characteristics of fluid flow; equation of continuity  $v_1 a_1 = v_2 a_2$ ; conditions; applications like use of nozzle at the end of a hose; Bernoulli's principle (theorem); assumptions - incompressible liquid, streamline (steady) flow, non-viscous and irrotational liquid - ideal liquid; derivation of equation; applications of Bernoulli's theorem atomizer, dynamic uplift, Venturimeter, Magnus effect etc.*

(c) *Streamline and turbulent flow - examples; streamlines do not intersect (like electric and magnetic lines of force); tubes of flow; number of streamlines per unit area  $\propto$  velocity of flow (from equation of continuity  $v_1 a_1 = v_2 a_2$ ); critical velocity; Reynold's number (significance only) Poiseuille's formula with numericals.*

(d) *Viscous drag; Newton's formula for viscosity, co-efficient of viscosity and its units.*

*Flow of fluids (liquids and gases), laminar flow, internal friction between layers of fluid, between fluid and the solid with which the fluid is in relative motion; examples; viscous drag is a force of friction; mobile and viscous liquids.*

*Velocity gradient  $dv/dx$  (space rate of change of velocity); viscous drag  $F = \eta A dv/dx$ ; coefficient of viscosity  $\eta = F/A (dv/dx)$  depends on the nature of the liquid and its temperature; units:  $Ns/m^2$  and  $dyn.s/cm^2 = poise. 1 poise = 0.1 Ns/m^2$ .*

(e) *Stoke's law, motion of a sphere falling through a fluid, hollow rigid sphere rising to the surface of a liquid, parachute, obtain the expression of terminal velocity; forces acting; viscous drag, a force proportional to velocity; Stoke's law;  $v-t$  graph.*

(f) *Surface tension (molecular theory), drops and bubbles, angle of contact, work done in stretching a surface and surface energy, capillary rise, measurement of surface tension by capillary (uniform bore) rise method. Excess pressure across a curved surface, application of surface tension for drops and bubbles.*

## 8. Heat and Thermodynamics

(i) *Thermal Properties of Matter: Heat, temperature, thermal expansion; thermal expansion of solids, liquids and gases, anomalous expansion of water; specific heat*

*capacity, calorimetry; change of state, specific latent heat capacity.*

*Heat transfer-conduction, convection and radiation, thermal conductivity, qualitative ideas of Blackbody radiation, Wein's displacement Law, Stefan's law, and Greenhouse effect.*

(a) *Temperature and Heat, measurement of temperature (scales and inter conversion). Ideal gas equation and absolute temperature, thermal expansion in solids, liquids and gases. Specific heat capacity, calorimetry, change of state, latent heat capacity, steady state and temperature gradient. Thermal conductivity; co-efficient of thermal conductivity, Use of good and poor conductors, Searle's experiment, (Lee's Disc method is not required). Convection with examples.*

(b) *Black body is now called ideal or cavity radiator and black body radiation is cavity radiation; Stefan's law is now known as Stefan Boltzmann law as Boltzmann derived it theoretically. There is multiplicity of technical terms related to thermal radiation - radiant intensity  $I (T)$  for total radiant power (energy radiated/second) per unit area of the surface, in  $W/m^2$ ,  $I (T) = \sigma T^4$ ; dimension and SI unit of  $\sigma$ . For practical radiators  $I = \epsilon \cdot \sigma T^4$  where  $\epsilon$  (dimension less) is called emissivity of the surface material;  $\epsilon=1$  for ideal radiators. The Spectral radiancy  $R(\lambda)$ .  $I (T) = \int_0^\alpha R(\lambda) d\lambda$ .*

*Graph of  $R(\lambda)$  vs  $\lambda$  for different temperatures. Area under the graph is  $I (T)$ . The  $\lambda$  corresponding to maximum value of  $R$  is called  $\lambda_{max}$ ; decreases with increase in temperature.*

*Wien's displacement law; Stefan's law and Newton's law of cooling. [Deductions from Stefan's law not necessary]. Greenhouse effect – self-explanatory.*

(ii) Thermodynamics

Thermal equilibrium and definition of temperature (zeroth law of thermodynamics), heat, work and internal energy. First law of thermodynamics, isothermal and adiabatic processes.

Second law of thermodynamics: reversible and irreversible processes, Heat engine and refrigerator.

(a) *Thermal equilibrium and zeroth law of thermodynamics: Self explanatory*

(b) *First law of thermodynamics.*

*Concept of heat (Q) as the energy that is transferred (due to temperature difference only) and not stored; the energy that is stored in a body or system as potential and kinetic energy is called internal energy (U). Internal energy is a state property (only elementary ideas) whereas, heat is not; first law is a statement of conservation of energy, when, in general, heat (Q) is transferred to a body (system), internal energy (U) of the system changes and some work W is done by the system; then  $Q = \Delta U + W$ ; also  $W = \int p dV$  for working substance - an ideal gas; explain the meaning of symbols (with examples) and sign convention carefully (as used in physics:  $Q > 0$  when added to a system,  $\Delta U > 0$  when U increases or temperature rises, and  $W > 0$  when work is done by the system). Special cases for  $Q = 0$  (adiabatic),  $\Delta U = 0$  (isothermal) and  $W = 0$  (isochoric).*

(c) *Isothermal and adiabatic changes in a perfect gas described in terms of PV graphs;  $PV = \text{constant}$  (Isothermal) and  $PV^\gamma = \text{constant}$  (adiabatic); joule and calorie relation (derivation of  $PV^\gamma = \text{constant}$  not required).*

*Note that 1 cal = 4.186 J exactly and J (so-called mechanical equivalent of heat) should not be used in equations. In equations, it is understood that each term as well as the LHS and RHS are in the same units; it could be all joules or all calories.*

(d) *Derive an expression for work done in isothermal and adiabatic processes; principal and molar heat capacities;  $C_p$  and  $C_v$ ; relation between  $C_p$  and  $C_v$  ( $C_p - C_v = R$ ). Work done as area bounded by PV graph.*

(e) *Second law of thermodynamics, Carnot's cycle. Some practical applications.*

*Only one statement each in terms of Kelvin's impossible steam engine and Clausius' impossible refrigerator. Brief explanation of the law. Reversible and irreversible processes, Heat engine; Carnot's cycle - describe realisation from source and sink of infinite thermal capacity, thermal insulation, etc. Explain using pV graph (isothermal process and adiabatic process) expression and numericals (without derivation) for efficiency  $\eta = 1 - T_2/T_1$ , Refrigerator and heat pumps.*

## 9. Behaviour of Perfect Gases and Kinetic Theory of Gases

(i) *Kinetic Theory: Equation of state of a perfect gas, work done in compressing a gas. Kinetic theory of gases - assumptions, concept of pressure. Kinetic interpretation of temperature; rms speed of gas molecules; degrees of freedom, law of equi-partition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.*

(a) *Kinetic Theory of gases; derive  $p = \frac{1}{3} \rho \overline{c^2}$  from the assumptions and applying Newton's laws of motion. The average thermal velocity (rms value)  $c_{rms} = \sqrt{3p/\rho}$ ; calculations for air, hydrogen and their comparison with common speeds. Effect of temperature and pressure on rms speed of gas molecules.*

*[Note that  $pV = nRT$  the ideal gas equation cannot be derived from kinetic theory of ideal gas. Hence, neither can other gas laws;  $pV = nRT$  is an experimental result. Comparing this with  $p = \frac{1}{3} \rho \overline{c^2}$ , from kinetic theory of gases, a kinetic interpretation of temperature can be obtained as explained in the next subunit].*

(b) From kinetic theory for an ideal gas (obeying all the assumptions especially no intermolecular attraction and negligibly small size of molecules, we get  $p = (1/3)\rho \overline{c^2}$  or  $pV = (1/3)M\overline{c^2}$ . (No further, as temperature is not a concept of kinetic theory). From experimentally obtained gas laws, we have the ideal gas equation (obeyed by some gases at low pressure and high temperature)  $pV = RT$  for one mole. Combining these two results (assuming they can be combined),  $RT = (1/3)M\overline{c^2} = (2/3) \cdot \frac{1}{2}M\overline{c^2} = (2/3)K$ ; Hence, kinetic energy of 1 mole of an ideal gas  $K = (3/2)RT$ . Average K for 1 molecule =  $K/N = (3/2) RT/N = (3/2) kT$  where  $k$  is Boltzmann's constant. So, temperature  $T$  can be interpreted as a measure of the average kinetic energy of the molecules of a gas.

(c) Degrees of freedom and calculation of specific heat capacities for all types of gases. Concept of the law of equipartition of energy (derivation not required). Concept of mean free path and Avogadro's number  $N_A$ .

## 10. Oscillations and Waves

(i) Oscillations: Periodic motion, time period, frequency, displacement as a function of time, periodic functions. Simple harmonic motion (S.H.M) and its equation; phase; oscillations of a spring, restoring force and force constant; energy in S.H.M., Kinetic and potential energies; simple pendulum and derivation of expression for its time period.

Free, forced and damped oscillations (qualitative ideas only), resonance.

(a) Simple harmonic motion. Periodic motion, time period  $T$  and frequency  $f$ ,  $f=1/T$ ; uniform circular motion and its projection on a diameter defines SHM; displacement, amplitude, phase and epoch, velocity, acceleration, time period; characteristics of SHM; Relation between linear simple harmonic motion and uniform circular motion. Differential equation of SHM,  $d^2y/dt^2 + \omega^2y = 0$  from

the nature of force acting  $F = -k y$ ; solution  $y = A \sin(\omega t + \phi_0)$  where  $\omega^2 = k/m$ ; obtain expressions for velocity, acceleration, time period  $T$  and frequency  $f$ . Graphical representation of displacement, velocity and acceleration. Examples, simple pendulum, a mass  $m$  attached to a spring of spring constant  $k$ . Derivation of time period of simple harmonic motion of a simple pendulum, mass on a spring (horizontal and vertical oscillations) Kinetic and potential energy at a point in simple harmonic motion. Total energy  $E = U + K$  (potential + kinetic) is conserved. Draw graphs of  $U$ ,  $K$  and  $E$  Verses  $y$ .

(b) Free, forced and damped oscillations (qualitative treatment only). Resonance. Examples of damped oscillations (all oscillations are damped); graph of amplitude vs time for undamped and damped oscillations; damping force in addition to restoring force ( $-ky$ ); forced oscillations, examples; action of an external periodic force, in addition to restoring force. Time period is changed to that of the external applied force, amplitude ( $A$ ) varies with frequency ( $f$ ) of the applied force and it is maximum when the frequency of the external applied force is equal to the natural frequency of the vibrating body. This is resonance; maximum energy transfer from one body to the other; bell graph of amplitude vs frequency of the applied force. Examples from mechanics, electricity and electronics (radio).

(ii) Waves: Wave motion, Transverse and longitudinal waves, speed of wave motion, displacement relation for a progressive wave, principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect.

(a) Transverse and longitudinal waves; characteristics of a harmonic wave; graphical representation of a harmonic wave. Distinction between transverse and longitudinal waves; examples; displacement, amplitude, time period,

frequency, wavelength, derive  $v=f\lambda$ ; graph of displacement with time/position, label time period/wavelength and amplitude, equation of a progressive harmonic (sinusoidal) wave,  $y = A \sin(kx \pm \omega t)$  where  $k$  is a propagation factor and equivalent equations.

- (b) Production and propagation of sound as a wave motion; mechanical wave requires a medium; general formula for speed of sound (no derivation). Newton's formula for speed of sound in air; experimental value; Laplace's correction; variation of speed  $v$  with changes in pressure, density, humidity and temperature. Speed of sound in liquids and solids - brief introduction only. Concept of supersonic and ultrasonic waves.
- (c) Principle of superposition of waves; interference (simple ideas only); dependence of combined wave form, on the relative phase of the interfering waves; qualitative only - illustrate with wave representations. Beats (qualitative explanation only); number of beats produced per second = difference in the frequencies of the interfering waves. Standing waves or stationary waves; formation by two identical progressive waves travelling in opposite directions (e.g., along a string, in an air column - incident and reflected waves); obtain  $y = y_1 + y_2 = [2 y_m \sin(kx)] \cos(\omega t)$  using equations of the travelling waves; variation of the amplitude  $A = 2 y_m \sin(kx)$  with location ( $x$ ) of the particle; nodes and antinodes; compare standing waves with progressive waves.
- (d) Laws of vibrations of a stretched string. Obtain equation for fundamental frequency  $f_0 = (1/2l) \sqrt{T/m}$ ; sonometer.
- (e) Modes of vibration of strings and air columns (closed and open pipes); standing waves with nodes and antinodes; also in resonance with the periodic force exerted usually by a tuning fork; sketches of various modes of vibration; obtain expressions for fundamental frequency and various harmonics and overtones; mutual relations.

- (f) Doppler effect for sound; obtain general expression for apparent frequency when both the source and listener are moving, given as  $f_L = f_r \left( \frac{v \pm v_L}{v \pm v_r} \right)$  which can be reduced to any one of the four special cases, by using proper sign.

## PAPER II

### PRACTICAL WORK- 15 Marks

**Given below is a list of required experiments. Teachers may add to this list, keeping in mind the general pattern of questions asked in the annual examinations.**

In each experiment, students are expected to record their observations in a tabular form with units at the column head. Students should plot an appropriate graph, work out the necessary calculations and arrive at the result.

**Students are required to have completed all experiments from the given list (excluding demonstration experiments):**

- To measure the diameter of a spherical body using Vernier calipers. Calculate its volume with appropriate significant figures. Also measure its volume using a graduated cylinder and compare the two.
- Find the diameter of a wire using a micrometer screw gauge and determine percentage error in cross sectional area.
- Determine radius of curvature of a spherical surface like watch glass by a spherometer.
- Equilibrium of three concurrent coplanar forces. To verify the parallelogram law of forces and to determine weight of a body.
- (i) Inclined plane: To find the downward force acting along the inclined plane on a roller due to gravitational pull of earth and to study its relationship with angle of inclination by plotting graph between force and  $\sin \theta$ .  
(ii) Friction: To find the force of limiting friction for a wooden block placed on horizontal surface and to study its relationship with normal reaction. To determine the coefficient of friction.

6. To find the acceleration due to gravity by measuring the variation in time period (T) with effective length (L) of a simple pendulum; plot graphs of T vs  $\sqrt{L}$  and  $T^2$  vs L. Determine effective length of the seconds pendulum from  $T^2$  vs L graph.
7. To find the force constant of a spring and to study variation in time period of oscillation with mass m of a body suspended by the spring. To find acceleration due to gravity by plotting a graph of T against  $\sqrt{m}$ .
8. Boyle's Law: To study the variation in volume with pressure for a sample of air at constant temperature by plotting graphs between p and  $\frac{1}{V}$  and between p and V.
9. Cooling curve: To study the fall in temperature of a body (like hot water or liquid in calorimeter) with time. Find the slope of the curve at four different temperatures of the hot body and hence, deduce Newton's law of cooling.
10. To study the variation in frequency of air column with length using resonance column apparatus or a long cylindrical vessel and a set of tuning forks. Hence, determine velocity of sound in air at room temperature.
11. To determine frequency of a tuning fork using a sonometer.
12. To determine specific heat capacity of a solid using a calorimeter.

**Demonstration Experiments** (*The following experiments are to be demonstrated by the teacher*):

1. Searle's method to determine Young modulus of elasticity.
2. Capillary rise method to determine surface tension of water.
3. Determination of coefficient of viscosity of a given viscous liquid by terminal velocity method.

**PROJECT WORK AND PRACTICAL FILE –  
15 Marks**

**Project Work – 10 Marks**

All candidates will be required to do **one** project involving some Physics related topic/s, under the guidance and regular supervision of the Physics teacher. Candidates are to prepare a technical report including an abstract, some theoretical discussion, experimental setup, observations with tables of data collected, analysis and discussion of results, deductions, conclusion, etc. (after the draft has been approved by the teacher). The report should be kept simple, but neat and elegant. Teachers may assign or students may choose any one project of their choice.

**Suggested Evaluation criteria:**

▪ Title and Abstract (summary)
▪ Introduction / purpose
▪ Contents/Presentation
▪ Analysis/ material aid (graph, data, structure, pie charts, histograms, diagrams, etc.)
▪ Originality of work
▪ Conclusion/comments

**Practical File – 5 Marks**

Teachers are required to assess students on the basis of the Physics practical file maintained by them during the academic year.

**NOTE: For guidelines regarding Project Work, please refer to Class XII.**



## CLASS XII

There will be two papers in the subject:

**Paper I:** Theory - 3 hours ... 70 marks

**Paper II:** Practical - 3 hours ... 15 marks

Project Work ... 10 marks

Practical File ... 5 marks

### **PAPER I- THEORY: 70 Marks**

There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.

S. NO.	UNIT	TOTAL WEIGHTAGE
1.	Electrostatics	14 Marks
2.	Current Electricity	
3.	Magnetic Effects of Current and Magnetism	16 Marks
4.	Electromagnetic Induction and Alternating Currents	
5.	Electromagnetic Waves	
6.	Optics	18 Marks
7.	Dual Nature of Radiation and Matter	12 Marks
8.	Atoms and Nuclei	
9.	Electronic Devices	8 Marks
10.	Communication Systems	2 Marks
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I -THEORY- 70 Marks

**Note:** (i) Unless otherwise specified, only S. I. Units are to be used while teaching and learning, as well as for answering questions.

(ii) All physical quantities to be defined as and when they are introduced along with their units and dimensions.

(iii) Numerical problems are included from all topics except where they are specifically excluded or where only qualitative treatment is required.

### 1. Electrostatics

#### (i) Electric Charges and Fields

Electric charges; conservation and quantisation of charge, Coulomb's law; superposition principle and continuous charge distribution.

Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field.

Electric flux, Gauss's theorem in Electrostatics and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell.

(a) Coulomb's law, S.I. unit of charge; permittivity of free space and of dielectric medium. Frictional electricity, electric charges (two types); repulsion and attraction; simple atomic structure - electrons and ions; conductors and insulators; quantization and conservation of electric charge; Coulomb's law in vector form; (position coordinates  $r_1$ ,  $r_2$  not necessary). Comparison with Newton's law of gravitation; Superposition principle ( $\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13} + \vec{F}_{14} + \dots$ ).

(b) Concept of electric field and its intensity; examples of different fields; gravitational, electric and magnetic; Electric field due to a point charge  $\vec{E} = \vec{F} / q_0$  ( $q_0$  is a test charge);  $\vec{E}$  for a group of charges (superposition principle); a point charge  $q$  in an electric

field  $\vec{E}$  experiences an electric force  $\vec{F}_E = q\vec{E}$ . Intensity due to a continuous distribution of charge i.e. linear, surface and volume.

(c) Electric lines of force: A convenient way to visualize the electric field; properties of lines of force; examples of the lines of force due to (i) an isolated point charge (+ve and - ve); (ii) dipole, (iii) two similar charges at a small distance; (iv) uniform field between two oppositely charged parallel plates.

(d) Electric dipole and dipole moment; derivation of the  $\vec{E}$  at a point, (1) on the axis (end on position) (2) on the perpendicular bisector (equatorial i.e. broad side on position) of a dipole, also for  $r \gg 2l$  (short dipole); dipole in a uniform electric field; net force zero, torque on an electric dipole:  $\vec{\tau} = \vec{p} \times \vec{E}$  and its derivation.

(e) Gauss' theorem: the flux of a vector field;  $Q = vA$  for velocity vector  $\vec{v} \parallel \vec{A}$ ,

$\vec{A}$  is area vector. Similarly, for electric field  $\vec{E}$ , electric flux  $\phi_E = EA$  for  $\vec{E} \parallel \vec{A}$

and  $\phi_E = \vec{E} \cdot \vec{A}$  for uniform  $\vec{E}$ . For non-uniform field  $\phi_E = \int d\phi = \int \vec{E} \cdot d\vec{A}$ . Special cases for  $\theta = 0^\circ, 90^\circ$  and  $180^\circ$ . Gauss' theorem, statement:  $\phi_E = q/\epsilon_0$  or  $\phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{q}{\epsilon_0}$  where  $\phi_E$  is for

a closed surface;  $q$  is the net charge enclosed,  $\epsilon_0$  is the permittivity of free space. Essential properties of a Gaussian surface.

Applications: Obtain expression for  $\vec{E}$  due to 1. an infinite line of charge, 2. a uniformly charged infinite plane thin sheet, 3. a thin hollow spherical shell (inside, on the surface and outside). Graphical variation of  $E$  vs  $r$  for a thin spherical shell.

(ii) Electrostatic Potential, Potential Energy and Capacitance

Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field.

Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel. Capacitance of a parallel plate capacitor, energy stored in a capacitor.

(a) *Concept of potential, potential difference and potential energy. Equipotential surface and its properties. Obtain an expression for electric potential at a point due to a point charge; graphical variation of E and V vs r,  $V_P = W/q_0$ ; hence  $V_A - V_B = W_{BA}/q_0$  (taking  $q_0$  from B to A)  $= (q/4\pi\epsilon_0)(1/r_A - 1/r_B)$ ; derive this equation; also  $V_A = q/4\pi\epsilon_0 \cdot 1/r_A$ ; for  $q > 0$ ,  $V_A > 0$  and for  $q < 0$ ,  $V_A < 0$ . For a collection of charges  $V =$  algebraic sum of the potentials due to each charge; potential due to a dipole on its axial line and equatorial line; also at any point for  $r \gg 2l$  (short dipole). Potential energy of a point charge ( $q$ ) in an electric field  $\vec{E}$ , placed at a point P where potential is  $V$ , is given by  $U = qV$  and  $\Delta U = q(V_A - V_B)$ . The electrostatic potential energy of a system of two charges = work done  $W_{21} = W_{12}$  in assembling the system;  $U_{12}$  or  $U_{21} = (1/4\pi\epsilon_0) q_1 q_2 / r_{12}$ . For a system of 3 charges  $U_{123} = U_{12} + U_{13} + U_{23} = \frac{1}{4\pi\epsilon_0} \left( \frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right)$ . For a dipole in a uniform electric field, derive an expression of the electric potential energy  $U_E = -\vec{p} \cdot \vec{E}$ , special cases for  $\phi = 0^\circ, 90^\circ$  and  $180^\circ$ .*

(b) *Capacitance of a conductor  $C = Q/V$ ; obtain the capacitance of a parallel-plate capacitor ( $C = \epsilon_0 A/d$ ) and equivalent capacitance for capacitors in series and parallel combinations. Obtain an*

*expression for energy stored ( $U = \frac{1}{2} CV^2 = \frac{1}{2} QV = \frac{1}{2} \frac{Q^2}{C}$ ) and energy density.*

(c) *Dielectric constant  $K = C'/C$ ; this is also called relative permittivity  $K = \epsilon_r = \epsilon/\epsilon_0$ ; elementary ideas of polarization of matter in a uniform electric field qualitative discussion; induced surface charges weaken the original field; results in reduction in  $\vec{E}$  and hence, in pd, (V); for charge remaining the same  $Q = CV = C'V' = K \cdot CV'$ ;  $V' = V/K$ ; and  $E' = E/K$ ; if the Capacitor is kept connected with the source of emf,  $V$  is kept constant  $V = Q/C = Q'/C'$ ;  $Q' = C'V = K \cdot CV = K \cdot Q$  increases; For a parallel plate capacitor with a dielectric in between,  $C' = KC = K \cdot \epsilon_0 \cdot A/d = \epsilon_r \cdot \epsilon_0 \cdot A/d$ . Then  $C' = \frac{\epsilon_0 A}{\left( \frac{d}{\epsilon_r} \right)}$ ; for a capacitor partially filled dielectric, capacitance,  $C' = \epsilon_0 A / (d-t + t/\epsilon_r)$ .*

## 2. Current Electricity

Mechanism of flow of current in conductors. Mobility, drift velocity and its relation with electric current; Ohm's law and its proof, resistance and resistivity and their relation to drift velocity of electrons; V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity. Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance and resistivity.

Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel, Kirchhoff's laws and simple applications, Wheatstone bridge, metre bridge. Potentiometer - principle and its applications to measure potential difference, to compare emf of two cells; to measure internal resistance of a cell.

- (a) Free electron theory of conduction; acceleration of free electrons, relaxation time  $\tau$ ; electric current  $I = Q/t$ ; concept of drift velocity and electron mobility. Ohm's law, current density  $J = I/A$ ; experimental verification, graphs and slope, ohmic and non-ohmic conductors; obtain the relation  $I = v_d e n A$ . Derive  $\sigma = ne^2 \tau / m$  and  $\rho = m / ne^2 \tau$ ; effect of temperature on resistivity and resistance of conductors and semiconductors and graphs. Resistance  $R = V/I$ ; resistivity  $\rho$ , given by  $R = \rho l / A$ ; conductivity and conductance; Ohm's law as  $\vec{J} = \sigma \vec{E}$ ; colour coding of resistance.
- (b) Electrical energy consumed in time  $t$  is  $E = Pt = VIt$ ; using Ohm's law  $E = \left( \frac{V^2}{R} \right) t = I^2 R t$ . Potential difference  $V = P / I$ ;  $P = VI$ ; Electric power consumed  $P = VI = V^2 / R = I^2 R$ ; commercial units; electricity consumption and billing. Derivation of equivalent resistance for combination of resistors in series and parallel; special case of  $n$  identical resistors;  $R_s = nR$  and  $R_p = R/n$ . Calculation of equivalent resistance of mixed grouping of resistors (circuits).
- (c) The source of energy of a seat of emf (such as a cell) may be electrical, mechanical, thermal or radiant energy. The emf of a source is defined as the work done per unit charge to force them to go to the higher point of potential (from -ve terminal to +ve terminal inside the cell) so,  $\varepsilon = dW / dq$ ; but  $dq = Idt$ ;  $dW = \varepsilon dq = \varepsilon Idt$ . Equating total work done to the work done across the external resistor  $R$  plus the work done across the internal resistance  $r$ ;  $\varepsilon Idt = I^2 R dt + I^2 r dt$ ;  $\varepsilon = I(R + r)$ ;  $I = \varepsilon / (R + r)$ ; also  $IR + Ir = \varepsilon$  or  $V = \varepsilon - Ir$  where  $Ir$  is called the back emf as it acts against the emf  $\varepsilon$ ;  $V$  is the terminal pd. Derivation of formulae for combination for identical cells in series, parallel and mixed grouping. Parallel combination of two cells of unequal emf. Series combination of  $n$  cells of unequal emf.
- (d) Statement and explanation of Kirchhoff's laws with simple examples. The first is a conservation law for charge and the 2<sup>nd</sup> is

law of conservation of energy. Note change in potential across a resistor  $\Delta V = IR < 0$  when we go 'down' with the current (compare with flow of water down a river), and  $\Delta V = IR > 0$  if we go up against the current across the resistor. When we go through a cell, the -ve terminal is at a lower level and the +ve terminal at a higher level, so going from -ve to +ve through the cell, we are going up and  $\Delta V = +\varepsilon$  and going from +ve to -ve terminal through the cell, we are going down, so  $\Delta V = -\varepsilon$ . Application to simple circuits. Wheatstone bridge; right in the beginning take  $I_g = 0$  as we consider a balanced bridge, derivation of  $R_1/R_2 = R_3/R_4$  [Kirchhoff's law not necessary]. Metre bridge is a modified form of Wheatstone bridge, its use to measure unknown resistance. Here  $R_3 = l_1 \rho$  and  $R_4 = l_2 \rho$ ;  $R_3/R_4 = l_1/l_2$ . Principle of Potentiometer: fall in potential  $\Delta V \propto \Delta l$ ; auxiliary emf  $\varepsilon_1$  is balanced against the fall in potential  $V_1$  across length  $l_1$ .  $\varepsilon_1 = V_1 = Kl_1$ ;  $\varepsilon_1/\varepsilon_2 = l_1/l_2$ ; potentiometer as a voltmeter. Potential gradient and sensitivity of potentiometer. Use of potentiometer: to compare emfs of two cells, to determine internal resistance of a cell.

### 3. Magnetic Effects of Current and Magnetism

#### (i) Moving charges and magnetism

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application. Ampere's Circuital law and its applications to infinitely long straight wire, straight and toroidal solenoids (only qualitative treatment). Force on a moving charge in uniform magnetic and electric fields, cyclotron. Force on a current-carrying conductor in a uniform magnetic field, force between two parallel current-carrying conductors-definition of ampere, torque experienced by a current loop in uniform magnetic field; moving coil galvanometer - its sensitivity. Conversion of galvanometer into an ammeter and a voltmeter.

#### (ii) Magnetism and Matter:

A current loop as a magnetic dipole, its magnetic dipole moment, magnetic dipole moment of a revolving electron, magnetic

field intensity due to a magnetic dipole (bar magnet) on the axial line and equatorial line, torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; earth's magnetic field and magnetic elements. Diamagnetic, paramagnetic, and ferromagnetic substances, with examples. Electromagnets and factors affecting their strengths, permanent magnets.

- (a) Only historical introduction through Oersted's experiment. [Ampere's swimming rule not included]. Biot-Savart law and its vector form; application; derive the expression for  $\vec{B}$  (i) at the centre of a circular loop carrying current; (ii) at any point on its axis. Current carrying loop as a magnetic dipole. Ampere's Circuital law: statement and brief explanation. Apply it to obtain  $\vec{B}$  near a long wire carrying current and for a solenoid (straight as well as toroidal). Only formula of  $\vec{B}$  due to a finitely long conductor.
- (b) Force on a moving charged particle in magnetic field  $\vec{F}_B = q(\vec{v} \times \vec{B})$ ; special cases, modify this equation substituting  $d\vec{l}/dt$  for  $v$  and  $I$  for  $q/dt$  to yield  $\vec{F} = I d\vec{l} \times \vec{B}$  for the force acting on a current carrying conductor placed in a magnetic field. Derive the expression for force between two long and parallel wires carrying current, hence, define ampere (the base SI unit of current) and hence, coulomb; from  $Q = It$ . Lorentz force, Simple ideas about principle, working, and limitations of a cyclotron.
- (c) Derive the expression for torque on a current carrying loop placed in a uniform  $\vec{B}$ , using  $\vec{F} = I \vec{l} \times \vec{B}$  and  $\vec{\tau} = \vec{r} \times \vec{F}$ ;  $\tau = NIAB \sin \phi$  for  $N$  turns  $\vec{\tau} = \vec{m} \times \vec{B}$ , where the dipole moment  $\vec{m} = NI\vec{A}$ , unit:  $A.m^2$ . A current carrying loop is a magnetic dipole; directions of current and  $\vec{B}$  and  $\vec{m}$  using right hand rule only; no other rule necessary.

Mention orbital magnetic moment of an electron in Bohr model of H atom. Concept of radial magnetic field. Moving coil galvanometer; construction, principle, working, theory  $I = k\phi$ , current and voltage sensitivity. Shunt. Conversion of galvanometer into ammeter and voltmeter of given range.

- (d) Magnetic field represented by the symbol  $\vec{B}$  is now defined by the equation  $\vec{F} = q_o (\vec{v} \times \vec{B})$ ;  $\vec{B}$  is not to be defined in terms of force acting on a unit pole, etc.; note the distinction of  $\vec{B}$  from  $\vec{E}$  is that  $\vec{B}$  forms closed loops as there are no magnetic monopoles, whereas  $\vec{E}$  lines start from +ve charge and end on -ve charge. Magnetic field lines due to a magnetic dipole (bar magnet). Magnetic field in end-on and broadside-on positions (No derivations). Magnetic flux  $\phi = \vec{B} \cdot \vec{A} = BA$  for  $B$  uniform and  $\vec{B} \parallel \vec{A}$ ; i.e. area held perpendicular to  $\vec{B}$ . For  $\phi = BA(\vec{B} \parallel \vec{A})$ ,  $B = \phi/A$  is the flux density [SI unit of flux is weber (Wb)]; but note that this is not correct as a defining equation as  $\vec{B}$  is vector and  $\phi$  and  $\phi/A$  are scalars, unit of  $B$  is tesla (T) equal to  $10^4$  gauss. For non-uniform  $\vec{B}$  field,  $\phi = \int d\phi = \int \vec{B} \cdot d\vec{A}$ . Earth's magnetic field  $\vec{B}_E$  is uniform over a limited area like that of a lab; the component of this field in the horizontal direction  $B_H$  is the one effectively acting on a magnet suspended or pivoted horizontally. Elements of earth's magnetic field, i.e.  $B_H$ ,  $\delta$  and  $\theta$  - their definitions and relations.
- (e) Properties of diamagnetic, paramagnetic and ferromagnetic substances; their susceptibility and relative permeability.
- It is better to explain the main distinction, the cause of magnetization ( $M$ ) is due to magnetic dipole moment ( $m$ ) of atoms, ions or molecules being 0 for dia,  $>0$  but very small for para and

$> 0$  and large for ferromagnetic materials; few examples; placed in external  $\vec{B}$ , very small (induced) magnetization in a direction opposite to  $\vec{B}$  in dia, small magnetization parallel to  $\vec{B}$  for para, and large magnetization parallel to  $\vec{B}$  for ferromagnetic materials; this leads to lines of  $\vec{B}$  becoming less dense, more dense and much more dense in dia, para and ferro, respectively; hence, a weak repulsion for dia, weak attraction for para and strong attraction for ferro magnetic material. Also, a small bar suspended in the horizontal plane becomes perpendicular to the  $\vec{B}$  field for dia and parallel to  $\vec{B}$  for para and ferro. Defining equation  $H = (B/\mu_0) - M$ ; the magnetic properties, susceptibility  $\chi_m = (M/H) < 0$  for dia (as  $M$  is opposite  $H$ ) and  $> 0$  for para, both very small, but very large for ferro; hence relative permeability  $\mu_r = (1 + \chi_m) < 1$  for dia,  $> 1$  for para and  $\gg 1$  (very large) for ferro; further,  $\chi_m \propto 1/T$  (Curie's law) for para, independent of temperature ( $T$ ) for dia and depends on  $T$  in a complicated manner for ferro; on heating ferro becomes para at Curie temperature. Electromagnet: its definition, properties and factors affecting the strength of electromagnet; selection of magnetic material for temporary and permanent magnets and core of the transformer on the basis of retentivity and coercive force ( $B$ - $H$  loop and its significance, retentivity and coercive force not to be evaluated).

#### 4. Electromagnetic Induction and Alternating Currents

##### (i) Electromagnetic Induction

Faraday's laws, induced emf and current; Lenz's Law, eddy currents. Self-induction and mutual induction. Transformer.

##### (ii) Alternating Current

Peak value, mean value and RMS value of alternating current/voltage; their relation in sinusoidal case; reactance and impedance;

LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattless current. AC generator.

(a) Electromagnetic induction, Magnetic flux, change in flux, rate of change of flux and induced emf; Faraday's laws. Lenz's law, conservation of energy; motional emf  $\varepsilon = Blv$ , and power  $P = (Blv)^2/R$ ; eddy currents (qualitative);

(b) Self-Induction, coefficient of self-inductance,  $\phi = LI$  and  $L = \varepsilon/dI/dt$ ; henry = volt. Second/ampere, expression for coefficient of self-inductance of a solenoid  $L = \frac{\mu_0 N^2 A}{l} = \mu_0 n^2 A \times l$ .

Mutual induction and mutual inductance ( $M$ ), flux linked  $\phi_2 = MI_1$ ; induced emf

$$\varepsilon_2 = \frac{d\phi_2}{dt} = M \frac{dI_1}{dt}. \quad \text{Definition of } M \text{ as}$$

$$M = \frac{\varepsilon_2}{\frac{dI_1}{dt}} \text{ or } M = \frac{\phi_2}{I_1}. \quad \text{SI unit}$$

henry. Expression for coefficient of mutual inductance of two coaxial solenoids.

$$M = \frac{\mu_0 N_1 N_2 A}{l} = \mu_0 n_1 N_2 A \quad \text{Induced}$$

emf opposes changes, back emf is set up, eddy currents.

Transformer (ideal coupling): principle, working and uses; step up and step down; efficiency and applications including transmission of power, energy losses and their minimisation.

(c) Sinusoidal variation of  $V$  and  $I$  with time, for the output from an ac generator; time period, frequency and phase changes; obtain mean values of current and voltage, obtain relation between RMS value of  $V$  and  $I$  with peak values in sinusoidal cases only.

(d) Variation of voltage and current in a.c. circuits consisting of only a resistor, only an inductor and only a capacitor (phasor representation), phase lag and phase

lead. May apply Kirchhoff's law and obtain simple differential equation (SHM type),  $V = V_0 \sin \omega t$ , solution  $I = I_0 \sin \omega t$ ,  $I_0 \sin(\omega t + \pi/2)$  and  $I_0 \sin(\omega t - \pi/2)$  for pure R, C and L circuits respectively. Draw phase (or phasor) diagrams showing voltage and current and phase lag or lead, also showing resistance R, inductive reactance  $X_L$ ; ( $X_L = \omega L$ ) and capacitive reactance  $X_C$ , ( $X_C = 1/\omega C$ ). Graph of  $X_L$  and  $X_C$  vs  $f$ .

- (e) The LCR series circuit: Use phasor diagram method to obtain expression for  $I$  and  $V$ , the pd across R, L and C; and the net phase lag/lead; use the results of 4(e),  $V$  lags  $I$  by  $\pi/2$  in a capacitor,  $V$  leads  $I$  by  $\pi/2$  in an inductor,  $V$  and  $I$  are in phase in a resistor,  $I$  is the same in all three; hence draw phase diagram, combine  $V_L$  and  $V_C$  (in opposite phase; phasors add like vectors) to give  $V = V_R + V_L + V_C$  (phasor addition) and the max. values are related by  $V_m^2 = V_{Rm}^2 + (V_{Lm} - V_{Cm})^2$  when  $V_L > V_C$ . Substituting  $pd = \text{current} \times \text{resistance or reactance}$ , we get  $Z^2 = R^2 + (X_L - X_C)^2$  and  $\tan \phi = (V_{Lm} - V_{Cm})/V_{Rm} = (X_L - X_C)/R$  giving  $I = I_m \sin(\omega t - \phi)$  where  $I_m = V_m/Z$  etc. Special cases for RL and RC circuits. [May use Kirchhoff's law and obtain the differential equation] Graph of  $Z$  vs  $f$  and  $I$  vs  $f$ .

- (f) Power  $P$  associated with LCR circuit =  $\frac{1}{2} V_0 I_0 \cos \phi = V_{rms} I_{rms} \cos \phi = I_{rms}^2 R$ ; power absorbed and power dissipated; electrical resonance; bandwidth of signals and  $Q$  factor (no derivation); oscillations in an LC circuit ( $\omega_0 = 1/\sqrt{LC}$ ). Average power consumed averaged over a full cycle  $\bar{P} = (1/2) V_0 I_0 \cos \phi$ , Power factor  $\cos \phi = R/Z$ . Special case for pure R, L and C; choke coil (analytical only),  $X_L$  controls current but  $\cos \phi = 0$ , hence  $\bar{P} = 0$ , wattless current; LC circuit; at resonance with  $X_L = X_C$ ,  $Z = Z_{min} = R$ , power delivered to circuit by the source is

maximum, resonant frequency

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

- (g) Simple a.c. generators: Principle, description, theory, working and use. Variation in current and voltage with time for a.c. and d.c. Basic differences between a.c. and d.c.

## 5. Electromagnetic Waves

Basic idea of displacement current. Electromagnetic waves, their characteristics, their transverse nature (qualitative ideas only). Complete electromagnetic spectrum starting from radio waves to gamma rays: elementary facts of electromagnetic waves and their uses.

Concept of displacement current, qualitative descriptions only of electromagnetic spectrum; common features of all regions of electromagnetic spectrum including transverse nature ( $\vec{E}$  and  $\vec{B}$  perpendicular to  $\vec{c}$ ); special features of the common classification (gamma rays, X rays, UV rays, visible light, IR, microwaves, radio and TV waves) in their production (source), detection and other properties; uses; approximate range of  $\lambda$  or  $f$  or at least proper order of increasing  $f$  or  $\lambda$ .

## 6. Optics

- (i) Ray Optics and Optical Instruments

Ray Optics: Reflection of light by spherical mirrors, mirror formula, refraction of light at plane surfaces, total internal reflection and its applications, optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens maker's formula, magnification, power of a lens, combination of thin lenses in contact, combination of a lens and a mirror, refraction and dispersion of light through a prism. Scattering of light.

Optical instruments: Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers and their resolving powers.

- (a) Reflection of light by spherical mirrors. Mirror formula: its derivation;  $R=2f$  for spherical mirrors. Magnification.
- (b) Refraction of light at a plane interface, Snell's law; total internal reflection and critical angle; total reflecting prisms and optical fibers. Total reflecting prisms: application to triangular prisms with angle of the prism  $30^\circ$ ,  $45^\circ$ ,  $60^\circ$  and  $90^\circ$  respectively; ray diagrams for Refraction through a combination of media,  $n_1 n_2 \times n_3 \times n_1 = 1$ , real depth and apparent depth. Simple applications.
- (c) Refraction through a prism, minimum deviation and derivation of relation between  $n$ ,  $A$  and  $\delta_{\min}$ . Include explanation of  $i$ - $\delta$  graph,  $i_1 = i_2 = i$  (say) for  $\delta_m$ ; from symmetry  $r_1 = r_2$ ; refracted ray inside the prism is parallel to the base of the equilateral prism. Thin prism. Dispersion; Angular dispersion; dispersive power, rainbow - ray diagram (no derivation). Simple explanation. Rayleigh's theory of scattering of light: blue colour of sky and reddish appearance of the sun at sunrise and sunset clouds appear white.
- (d) Refraction at a single spherical surface; detailed discussion of one case only - convex towards rarer medium, for spherical surface and real image. Derive the relation between  $n_1$ ,  $n_2$ ,  $u$ ,  $v$  and  $R$ . Refraction through thin lenses: derive lens maker's formula and lens formula; derivation of combined focal length of two thin lenses in contact. Combination of lenses and mirrors (silvering of lens excluded) and magnification for lens, derivation for biconvex lens only; extend the results to biconcave lens, plano convex lens and lens immersed in a liquid; power of a lens  $P=1/f$  with SI unit dioptre. For lenses in contact  $1/F=1/f_1+1/f_2$  and  $P=P_1+P_2$ . Lens formula, formation of image with combination of thin lenses and mirrors.
- [Any one sign convention may be used in solving numericals].
- (e) Ray diagram and derivation of magnifying power of a simple microscope with image at  $D$  (least distance of distinct vision) and infinity; Ray diagram and derivation of magnifying power of a compound microscope with image at  $D$ . Only expression for magnifying power of compound microscope for final image at infinity.
- Ray diagrams of refracting telescope with image at infinity as well as at  $D$ ; simple explanation; derivation of magnifying power; Ray diagram of reflecting telescope with image at infinity. Advantages, disadvantages and uses. Resolving power of compound microscope and telescope.
- (ii) Wave Optics
- Wave front and Huygen's principle. Proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width( $\beta$ ), coherent sources and sustained interference of light, Fraunhofer diffraction due to a single slit, width of central maximum; polarisation, plane polarised light, Brewster's law, uses of plane polarised light and Polaroids.
- (a) Huygen's principle: wavefronts - different types/shapes of wavefronts; proof of laws of reflection and refraction using Huygen's theory. [Refraction through a prism and lens on the basis of Huygen's theory not required].
- (b) Interference of light, interference of monochromatic light by double slit. Phase of wave motion; superposition of identical waves at a point, path difference and phase difference; coherent and incoherent sources; interference: constructive and destructive, conditions for sustained interference of light waves [mathematical deduction of interference from the equations of two progressive waves with a phase difference is not required]. Young's double slit experiment: set up, diagram, geometrical deduction of path difference  $\Delta x = d \sin \theta$ , between waves from the two slits; using



$\Delta x = n\lambda$  for bright fringe and  $\Delta x = (n + 1/2)\lambda$  for dark fringe and  $\sin \theta = \tan \theta = y_n/D$  as  $y$  and  $\theta$  are small, obtain  $y_n = (D/d)n\lambda$  and fringe width  $\beta = (D/d)\lambda$ . Graph of distribution of intensity with angular distance.

- (c) Single slit Fraunhofer diffraction (elementary explanation only). Diffraction at a single slit: experimental setup, diagram, diffraction pattern, obtain expression for position of minima, a  $\sin \theta_n = n\lambda$ , where  $n = 1, 2, 3, \dots$  and conditions for secondary maxima,  $a \sin \theta_n = (n + 1/2)\lambda$ ; distribution of intensity with angular distance; angular width of central bright fringe.
- (d) Polarisation of light, plane polarised electromagnetic wave (elementary idea only), methods of polarisation of light. Brewster's law; polaroids. Description of an electromagnetic wave as transmission of energy by periodic changes in  $\vec{E}$  and  $\vec{B}$  along the path; transverse nature as  $\vec{E}$  and  $\vec{B}$  are perpendicular to  $\vec{c}$ . These three vectors form a right handed system, so that  $\vec{E} \times \vec{B}$  is along  $\vec{c}$ , they are mutually perpendicular to each other. For ordinary light,  $\vec{E}$  and  $\vec{B}$  are in all directions in a plane perpendicular to the  $\vec{c}$  vector - unpolarised waves. If  $\vec{E}$  and (hence  $\vec{B}$  also) is confined to a single plane only ( $\perp \vec{c}$ , we have linearly polarized light. The plane containing  $\vec{E}$  (or  $\vec{B}$ ) and  $\vec{c}$  remains fixed. Hence, a linearly polarised light is also called plane polarised light. Plane of polarisation (contains  $\vec{E}$  and  $\vec{c}$ ); polarisation by reflection; Brewster's law:  $\tan i_p = n$ ; refracted ray is perpendicular to reflected ray for  $i = i_p$ ;  $i_p + r_p = 90^\circ$ ; polaroids; use in the production and detection/analysis of polarised light, other uses. Law of Malus.

## 7. Dual Nature of Radiation and Matter

Wave particle duality; photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation - particle nature of light. Matter waves - wave nature of particles, de-Broglie relation; conclusion from Davisson-Germer experiment. X-rays.

- (a) Photo electric effect, quantization of radiation; Einstein's equation  $E_{\max} = h\nu - W_0$ ; threshold frequency; work function; experimental facts of Hertz and Lenard and their conclusions; Einstein used Planck's ideas and extended it to apply for radiation (light); photoelectric effect can be explained only assuming quantum (particle) nature of radiation. Determination of Planck's constant (from the graph of stopping potential  $V_s$  versus frequency  $f$  of the incident light). Momentum of photon  $p = E/c = h\nu/c = h/\lambda$ .
- (b) De Broglie hypothesis, phenomenon of electron diffraction (qualitative only). Wave nature of radiation is exhibited in interference, diffraction and polarisation; particle nature is exhibited in photoelectric effect. Dual nature of matter: particle nature common in that it possesses momentum  $p$  and kinetic energy  $KE$ . The wave nature of matter was proposed by Louis de Broglie,  $\lambda = h/p = h/mv$ . Davisson and Germer experiment; qualitative description of the experiment and conclusion.
- (c) A simple modern X-ray tube (Coolidge tube) - main parts: hot cathode, heavy element anode (target) kept cool, all enclosed in a vacuum tube; elementary theory of X-ray production; effect of increasing filament current- temperature increases rate of emission of electrons (from the cathode), rate of production of X rays and hence, intensity of X rays increases (not its frequency); increase in anode potential increases energy of each electron, each X-ray photon and hence, X-ray frequency ( $E = h\nu$ ); maximum frequency  $h\nu_{\max} = eV$ ; continuous spectrum of X rays has minimum wavelength  $\lambda_{\min} = c/\nu_{\max} = hc/eV$ . Moseley's law. Characteristic and continuous X rays, their origin. (This topic is not to be evaluated)

## 8. Atoms and Nuclei

### (i) Atoms

Alpha-particle scattering experiment; Rutherford's atomic model; Bohr's atomic model, energy levels, hydrogen spectrum.

*Rutherford's nuclear model of atom (mathematical theory of scattering excluded), based on Geiger - Marsden experiment on  $\alpha$ -scattering; nuclear radius  $r$  in terms of closest approach of  $\alpha$  particle to the nucleus, obtained by equating  $\Delta K = \frac{1}{2} mv^2$  of the  $\alpha$  particle to the change in electrostatic potential energy  $\Delta U$  of the system*  
$$[U = \frac{2e \times Ze}{4\pi\epsilon_0 r_0} \quad r_0 \sim 10^{-15} m = 1 \text{ fermi}; \text{ atomic}$$

*structure; only general qualitative ideas, including atomic number  $Z$ , Neutron number  $N$  and mass number  $A$ . A brief account of historical background leading to Bohr's theory of hydrogen spectrum; formulae for wavelength in Lyman, Balmer, Paschen, Brackett and Pfund series. Rydberg constant. Bohr's model of  $H$  atom, postulates ( $Z=1$ ); expressions for orbital velocity, kinetic energy, potential energy, radius of orbit and total energy of electron. Energy level diagram, calculation of  $\Delta E$ , frequency and wavelength of different lines of emission spectra; agreement with experimentally observed values. [Use nm and not  $\text{\AA}$  for unit of  $\lambda$ ].*

### (ii) Nuclei

Composition and size of nucleus, Radioactivity, alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; Nuclear reactions, nuclear fission and nuclear fusion.

*(a) Atomic masses and nuclear density; Isotopes, Isobars and Isotones – definitions with examples of each. Unified atomic mass unit, symbol  $u$ ,  $1u = 1/12$  of the mass of  $^{12}\text{C}$  atom =  $1.66 \times 10^{-27} \text{kg}$ ). Composition of nucleus; mass defect and binding energy,  $BE = (\Delta m) c^2$ . Graph of  $BE/\text{nucleon}$  versus*

*mass number  $A$ , special features - less  $BE/\text{nucleon}$  for light as well as heavy elements. Middle order more stable [see fission and fusion] Einstein's equation  $E=mc^2$ . Calculations related to this equation; mass defect/binding energy, mutual annihilation and pair production as examples.*

*(b) Radioactivity: discovery; spontaneous disintegration of an atomic nucleus with the emission of  $\alpha$  or  $\beta$  particles and  $\gamma$  radiation, unaffected by physical and chemical changes. Radioactive decay law; derivation of  $N = N_0 e^{-\lambda t}$ ; half-life period  $T$ ; graph of  $N$  versus  $t$ , with  $T$  marked on the  $X$  axis. Relation between half-life ( $T$ ) and disintegration constant ( $\lambda$ ); mean life ( $\tau$ ) and its relation with  $\lambda$ . Value of  $T$  of some common radioactive elements. Examples of a few nuclear reactions with conservation of mass number and charge, concept of a neutrino.*

*Changes taking place within the nucleus included. [Mathematical theory of  $\alpha$  and  $\beta$  decay not included].*

### (c) Nuclear Energy

*Theoretical (qualitative) prediction of exothermic (with release of energy) nuclear reaction, in fusing together two light nuclei to form a heavier nucleus and in splitting heavy nucleus to form middle order (lower mass number) nuclei, is evident from the shape of  $BE$  per nucleon versus mass number graph. Also calculate the disintegration energy  $Q$  for a heavy nucleus ( $A=240$ ) with  $BE/A \sim 7.6 \text{ MeV}$  per nucleon split into two equal halves with  $A=120$  each and  $BE/A \sim 8.5 \text{ MeV/nucleon}$ ;  $Q \sim 200 \text{ MeV}$ . Nuclear fission: Any one equation of fission reaction. Chain reaction-controlled and uncontrolled; nuclear reactor and nuclear bomb. Main parts of a nuclear reactor including their functions - fuel elements, moderator, control rods, coolant, casing; criticality; utilization of energy output - all qualitative only. Fusion, simple example*

of  $4\ ^1\text{H} \rightarrow\ ^4\text{He}$  and its nuclear reaction equation; requires very high temperature  $\sim 10^6$  degrees; difficult to achieve; hydrogen bomb; thermonuclear energy production in the sun and stars. [Details of chain reaction not required].

## 9. Electronic Devices

- (i) Semiconductor Electronics: Materials, Devices and Simple Circuits. Energy bands in conductors, semiconductors and insulators (qualitative ideas only). Intrinsic and extrinsic semiconductors.
- (ii) Semiconductor diode: I-V characteristics in forward and reverse bias, diode as a rectifier; Special types of junction diodes: LED, photodiode, solar cell and Zener diode and its characteristics, zener diode as a voltage regulator.
- (iii) Junction transistor, npn and pnp transistor, transistor action, characteristics of a transistor and transistor as an amplifier (common emitter configuration).
- (iv) Elementary idea of analogue and digital signals, Logic gates (OR, AND, NOT, NAND and NOR). Combination of gates.

(a) *Energy bands in solids; energy band diagrams for distinction between conductors, insulators and semiconductors - intrinsic and extrinsic; electrons and holes in semiconductors.*

*Elementary ideas about electrical conduction in metals [crystal structure not included]. Energy levels (as for hydrogen atom), 1s, 2s, 2p, 3s, etc. of an isolated atom such as that of copper; these split, eventually forming 'bands' of energy levels, as we consider solid copper made up of a large number of isolated atoms, brought together to form a lattice; definition of energy bands - groups of closely spaced energy levels separated by band gaps called forbidden bands. An idealized representation of the energy bands for a conductor, insulator and semiconductor; characteristics, differences; distinction between conductors, insulators and semiconductors on the basis of energy bands, with examples; qualitative*

*discussion only; energy gaps (eV) in typical substances (carbon, Ge, Si); some electrical properties of semiconductors. Majority and minority charge carriers - electrons and holes; intrinsic and extrinsic, doping, p-type, n-type; donor and acceptor impurities.*

- (b) *Junction diode and its symbol; depletion region and potential barrier; forward and reverse biasing, V-I characteristics and numericals; half wave and a full wave rectifier. Simple circuit diagrams and graphs, function of each component in the electric circuits, qualitative only. [Bridge rectifier of 4 diodes not included]; elementary ideas on solar cell, photodiode and light emitting diode (LED) as semi conducting diodes. Importance of LED's as they save energy without causing atmospheric pollution and global warming. Zener diode, V-I characteristics, circuit diagram and working of zener diode as a voltage regulator.*
- (c) *Junction transistor; simple qualitative description of construction - emitter, base and collector; npn and pnp type; symbols showing direction of current in emitter-base region (one arrow only)-base is narrow; current gains in a transistor, relation between  $\alpha$ ,  $\beta$  and numericals related to current gain, voltage gain, power gain and transconductance; common emitter configuration only, characteristics;  $I_B$  vs  $V_{BE}$  and  $I_C$  vs  $V_{CE}$  with circuit diagram and numericals; common emitter transistor amplifier - circuit diagram; qualitative explanation including amplification, wave form and phase reversal.*
- (d) *Elementary idea of discreet and integrated circuits, analogue and digital signals. Logic gates as given; symbols, input and output, Boolean equations ( $Y=A+B$  etc.), truth table, qualitative explanation. NOT, OR, AND, NOR, NAND. Combination of gates [Realization of gates not included]. Advantages of Integrated Circuits.*

## 10. Communication Systems

Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data); bandwidth of transmission medium. Modes of propagation of electromagnetic waves in the atmosphere through sky and space waves, satellite communication. Modulation, types (frequency and amplitude), need for modulation and demodulation, advantages of frequency modulation over amplitude modulation. Elementary ideas about internet, mobile network and global positioning system (GPS).

*Self-explanatory- qualitative only.*

### PAPER II

#### PRACTICAL WORK- 15 Marks

The experiments for laboratory work and practical examinations are mostly from two groups:

- (i) experiments based on ray optics and
- (ii) experiments based on current electricity.

The main skill required in group (i) is to remove parallax between a needle and the real image of another needle.

In group (ii), understanding circuit diagram and making connections strictly following the given diagram is very important. Polarity of cells and meters, their range, zero error, least count, etc. should be taken care of.

A graph is a convenient and effective way of representing results of measurement. It is an important part of the experiment.

There will be one graph in the Practical question paper.

Candidates are advised to read the question paper carefully and do the work according to the instructions given in the question paper. Generally they are not expected to write the procedure of the experiment, formulae, precautions, or draw the figures, circuit diagrams, etc.

Observations should be recorded in a tabular form.

#### Record of observations

- All observations recorded should be consistent with the least count of the instrument used (e.g. focal length of the lens is 10.0 cm or 15.1cm but **10 cm is a wrong record.**)
- All observations should be recorded with correct units.

#### Graph work

Students should learn to draw graphs correctly noting all important steps such as:

- (i) Title
- (ii) Selection of origin (should be marked by two coordinates, example 0,0 or 5,0, or 0,10 or 30,5; **Kink is not accepted**).
- (i) The axes should be labelled according to the question
- (ii) Uniform and convenient scale should be taken and the units given along each axis (one small division = 0.33, 0.67, 0.66, etc. should not to be taken)
- (iii) Maximum area of graph paper (**at least 60% of the graph paper along both the axes**) should be used.
- (iv) Points should be plotted with great care, marking the points plotted with (should be a circle with a dot)  $\square$  or  $\otimes$ . A blob  $\bullet$  ) is a misplot.
- (v) The best fit straight line should be drawn. The best fit line does not necessarily have to pass through all the plotted points and the origin. While drawing the best fit line, **all experimental points must be kept on the line or symmetrically placed on the left and right side of the line**. The line should be continuous, thin, uniform and extended beyond the extreme plots.
- (vi) The intercepts must be read carefully. Y intercept i.e.  $y_0$  is that value of y when  $x = 0$ . Similarly, X intercept i.e.  $x_0$  is that value of x when  $y=0$ . **When  $x_0$  and  $y_0$  are to be read, origin should be at (0, 0).**

#### Deductions

- (i) The slope 'S' of the best fit line must be found taking two distant points (**using more than 50% of the line drawn**), which are not the plotted points, using  $S = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x}$ . Slope S must be calculated upto proper decimal place or significant figures as specified in the question paper.
- (ii) All calculations should be rounded off upto proper decimal place or significant figures, as specified in the question papers.

**NOTE:**

Short answer type questions may be set from each experiment to test understanding of theory and logic of steps involved.

**Given below is a list of required experiments. Teachers may add to this list, keeping in mind the general pattern of questions asked in the annual examinations.**

**Students are required to have completed all experiments from the given list (excluding demonstration experiments):**

1. To find focal length of a convex lens by using u-v method (no parallax method)

Using a convex lens, optical bench/metre scales and two pins, obtain the positions of the images for various positions of the object;  $f < u < 2f$ ,  $u \sim 2f$ , and  $u > 2f$ .

Draw the following set of graphs using data from the experiments -

(i)  $v$  against  $u$ . It will be a curve.

(ii) Magnification  $\left(m = \frac{v}{u}\right)$  against  $v$  which is a straight line and to find focal length by intercept.

(iii)  $y = (100/v)$  against  $x = (100/u)$  which is a straight line and find  $f$  by intercepts.

2. To find  $f$  of a convex lens by displacement method.
3. To determine the focal length of a given convex lens with the help of an auxiliary convex lens.
4. To determine the focal length of a concave lens, using an auxiliary convex lens, not in contact and plotting appropriate graph.
5. To determine focal length of concave mirror by using two pins (by u-v method).
6. To determine the refractive index of a liquid by using a convex lens and a plane mirror.
7. To determine the focal length of a convex mirror using convex lens.
8. Using a metre bridge, determine the resistance of about 100 cm of (constantan) wire. Measure its length and radius and hence, calculate the specific resistance of the material.

9. Verify Ohm's law for the given unknown resistance (a 60 cm constantan wire), plotting a graph of potential difference versus current. Also calculate the resistance per cm of the wire from the slope of the graph and the length of the wire.
10. To compare emfs of two cells using a potentiometer.
11. To determine the internal resistance of a cell by a potentiometer.
12. From a potentiometer set up, measure the fall in potential (i.e. pd) for increasing lengths of a constantan wire, through which a steady current is flowing; plot a graph of pd (V) versus length (l). Calculate the potential gradient of the wire and specific resistance of its material. Q (i) Why is the current kept constant in this experiment? Q (ii) How can you increase the sensitivity of the potentiometer? Q (iii) How can you use the above results and measure the emf of a cell?
13. To verify the laws of combination of resistances (series and parallel) using metre bridge.

**Demonstration Experiments (*The following experiments are to be demonstrated by the teacher*):**

1. To convert a given galvanometer into (a) an ammeter of range, say 2A and (b) a voltmeter of range 4V.
2. To study I-V characteristics of a semi-conductor diode in forward and reverse bias.
3. To study characteristics of a Zener diode and to determine its reverse breakdown voltage.
4. To study the characteristics of pnp/npn transistor in common emitter configuration.
5. To determine refractive index of a glass slab using a traveling microscope.
6. To observe polarization of light using two polaroids
7. Identification of diode, LED, transistor, IC, resistor, capacitor from mixed collection of such items.
8. Use of multimeter to (i) identify base of transistor, (ii) distinguish between npn and pnp type transistors, (iii) see the unidirectional flow of current in case of diode and an LED, (iv) check whether a given electronic component (e.g. diode, transistors, IC) is in working order.
9. Charging and discharging of a capacitor.

**PROJECT WORK AND PRACTICAL FILE –  
15 marks**

**Project Work – 10 marks**

The Project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

All candidates will be required to do **one** project involving some physics related topic/s under the guidance and regular supervision of the Physics teacher.

Candidates should undertake any **one** of the following types of projects:

- Theoretical project
- Working Model
- Investigatory project (by performing an experiment under supervision of a teacher)

Candidates are to prepare a technical report including title, abstract, some theoretical discussion, experimental setup, observations with tables of data collected, graph/chart (if any), analysis and discussion of results, deductions, conclusion, etc. The teacher should approve the draft, before it is finalised. The report should be kept simple, but neat and elegant. Teachers may assign or students may choose **any one** project of their choice.

**Suggested Evaluation Criteria for Theory Based Projects:**

▪ Title of the Project
▪ Introduction
▪ Contents
▪ Analysis/ material aid (graph, data, structure, pie charts, histograms, diagrams, etc.)
▪ Originality of work (the work should be the candidates' original work,)
▪ Conclusion/comments

**Suggested Evaluation Criteria for Model Based Projects:**

▪ Title of the Project
▪ Model construction
▪ Concise Project report

**Suggested Evaluation Criteria for Investigative Projects:**

▪ Title of the Project
▪ Theory/principle involved
▪ Experimental setup
▪ Observations calculations/deduction and graph work
▪ Result/ Conclusions

**Practical File – 5 marks**

The Visiting Examiner is required to assess the candidates on the basis of the Physics practical file maintained by them during the academic year.

## CHEMISTRY (862)

### Aims:

1. To foster acquisition of knowledge and understanding of terms, concepts, facts, processes, techniques and principles relating to the subject of Chemistry.
2. To develop the ability to apply the knowledge of contents and principles of Chemistry in new or unfamiliar situations.
3. To develop skills in proper handling of apparatus and chemicals.
4. To develop an ability to appreciate achievements in the field of Chemistry and its role in nature and society.
5. To develop an interest in activities involving usage of the knowledge of Chemistry.
6. To develop a scientific attitude through the study of Physical Sciences.
7. To acquaint students with the emerging frontiers and interdisciplinary aspects of the subject.
8. To develop skills relevant to the discipline.
9. To apprise students with interface of Chemistry with other disciplines of Science, such as, Physics, Biology, Geology, Engineering, etc.

### CLASS XI

*There will be two papers in the subject:*

**Paper I:** Theory- 3 hours ... 70 marks

**Paper II:** Practical - 3 hours ... 15 marks

*Project Work* ... 10 marks

*Practical File* ... 5 marks

### PAPER 1- THEORY: 70 Marks

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

S.No.	UNIT	TOTAL WEIGHTAGE
1.	Some Basic Concepts of Chemistry	<b>Physical Chemistry 32 Marks</b>
2.	Structure of Atom	
3.	Classification of Elements and Periodicity in Properties	
4.	Chemical Bonding and Molecular Structure	
5.	States of Matter: Gases and Liquids	
6.	Chemical Thermodynamics	
7.	Equilibrium	
8.	Redox Reactions	<b>Inorganic Chemistry 15 Marks</b>
9.	Hydrogen	
10.	s -Block Elements	
11.	Some p -Block Elements	
12.	Organic Chemistry: Some basic Principles and Techniques	<b>Organic Chemistry 23 Marks</b>
13.	Hydrocarbons	
14.	Environmental Chemistry	
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I –THEORY – 70 Marks

### 1. Some Basic Concepts of Chemistry

General introduction: Importance and scope of chemistry.

Study of matter. Understanding laws of chemical combination. Dalton's atomic theory: concept of elements, atoms and molecules.

Isotopic (atomic) and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula. Stoichiometry and calculations based on chemical reactions.

(i) *Precision and accuracy:*

*Quantities and their measurements in Chemistry, significant figures, SI units.*

(ii) *Dimensional analysis:*

*Conversion of units, numericals and applications of units.*

(iii) *The concept of atoms having fixed properties in explaining the laws of chemical combination.*

*Study about atoms. Dalton's atomic theory: Main postulates of the theory; its limitations.*

*Laws of chemical combinations:*

- *Law of conservation of mass.*
- *Law of definite proportions.*
- *Law of multiple proportions.*
- *Law of reciprocal proportions.*
- *Gay Lussac's law of gaseous volumes.*

*Statement, explanation and simple problems based on these laws.*

(iv) *Atomic (isotopic masses) and molecular mass.*

*Relative molecular mass and mole:*

*The atomic mass unit is one of the experimentally determined unit. It is equal to 1/12 of the mass of the carbon 12 isotope.*

*Numerical problems based on mole concept, Avogadro's number and gram molecular volume.*

(v) *Empirical and molecular formula: Numericals based on the above.*

(vi) *Chemical equivalents, volumetric calculations in terms of normality. C = 12.00 should be taken as a standard for expressing atomic masses.*

*Equivalent weight expressing the combining capacity of the elements with the standard elements such as H, Cl, O, Ag, etc.*

*Variable equivalent weight. Gram equivalent weights, relationship between gram equivalent weight, gram molecular mass and valency.*

*Determination of equivalent weight of acids, alkalis, salts, oxidising and reducing agents. (experimental details not required).*

*Terms used in volumetric calculations such as percentage (w/w and w/v), normality, molarity, molality, mole fraction, etc. should be discussed. Students are required to know the formulae and normality and molarity equations.*

*Simple calculations on the above topics.*

(vii) *Chemical reactions – stoichiometric calculations based on mass-mass, mass-volume, volume-volume relationships and limiting reagent.*

### 2. Structure of Atom

Discovery of fundamental particles (electron, proton and neutron), atomic number, isotopes and isobars. Thomson's model and its limitations. Rutherford's experimental model and its limitations. Dual nature of matter and light. Bohr's atomic model and its limitations (de Broglie's equation, Heisenberg's uncertainty principle), concept of shells, subshells, orbitals. Quantum numbers, shapes of s, p and d orbitals. Rules for filling electrons in orbitals - aufbau principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity. Electronic configuration of atoms, stability of half-filled and completely filled orbitals.

(i) *Subatomic particles (electrons, protons and neutrons) their charges and masses: Concept of indivisibility of atom as proposed by Dalton does not exist. The atom consists of subatomic fundamental particles. Production of cathode rays and their properties. Production of anode rays and their properties.*



*Chadwick's experiment for the discovery of neutron and properties of neutron.*

(ii) *Rutherford's nuclear model based on the scattering experiment: Rutherford's scattering experiment. Discovery of nucleus. Rutherford's nuclear model of atom. Defects of Rutherford's model. Electromagnetic wave theory and its limitations (Black body radiation and photoelectric effect)*

*Planck's quantum theory.*

*Numericals based on the above.*

(iii) *Types of spectra: emission and absorption spectra. Band and line spectra to be discussed.*

(iv) *Bohr's atomic model.*

*Postulates of Bohr's theory – based on Planck's quantum theory.*

*Merits of Bohr's atomic model and explanation of hydrogen spectra.*

*Calculations based on Rydberg's formula.*

*Numericals on Bohr's atomic radii, velocity and energy of orbits (derivation not required).*

*Defects in Bohr's Model.*

(v) *Quantum mechanical model of an atom - a simple mathematical treatment. Quantum numbers; shape, size and orientation of s, p and d orbitals only (no derivation). aufbau principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity. Electronic configuration of elements in terms of s, p, d, f subshells.*

- *de Broglie's equation. Numericals.*
- *Heisenberg's Uncertainty Principle. Numericals.*
- *Schrodinger Wave Equation – physical significance of  $\Psi$  and  $|\Psi|^2$ .*
- *Quantum numbers – types of quantum numbers, shape, size and orientation of the s, p and d subshells. Information obtained in terms of distance of electron from the nucleus, node, nodal planes and radial probability curve, energy of electron, number of electrons present in an orbit and an orbital.*
- *aufbau principle, (n+l) rule.*

- *Pauli's exclusion principle.*
- *Hund's rule of maximum multiplicity.*
- *Electronic configuration of elements and ions in terms of s, p, d, f subshells and stability of half-filled and completely filled orbitals.*

### **3. Classification of Elements and Periodicity in Properties**

Significance of classification; study of Mendeleev's periodic law and its limitations; Modern Periodic Law and the present form of periodic table leading to periodic trends in properties of elements - atomic radii, ionic radii, valency, ionisation enthalpy, electron gain enthalpy, electronegativity. Nomenclature of elements with atomic number greater than 100.

(i) *Modern Periodic Law*

*Mendeleev's periodic law, defects in the Mendeleev's periodic table. Advantages and disadvantages. Modern periodic law (atomic number taken as the basis of classification of the elements).*

(ii) *Long form of Periodic Table.*

*General characteristics of groups and periods. Division of periodic table as s, p, d and f blocks. IUPAC nomenclature for elements with  $Z > 100$ .*

(iii) *Periodic trends in properties of elements.*

*Atomic radius, ionic radius, ionisation enthalpy, electron gain enthalpy, electronegativity, metallic and non-metallic characteristics.*

- *Periodic properties such as valence electrons, atomic and ionic radii and their variation in groups and periods.*
- *The idea of ionisation enthalpy, electron gain enthalpy and electronegativity must be given and their variation in groups and periods may be discussed.*
- *The factors (atomic number, screening effect and shielding effect, the number of electrons in the outermost orbit) which affect these periodic properties and their variation in groups and periods.*

(iv) *Periodic trends in chemical properties – periodicity of valence or oxidation states. Anomalous properties of second period elements.*

*Diagonal relationship; acidic and basic nature of oxides.*

**NOTE:** *Recommendations of the latest IUPAC for numbering of groups to be followed. Numbering 1 – 18 replacing old notation of I – VIII. Details given at the end of the syllabus.*

#### 4. Chemical Bonding and Molecular structure

Valence electrons, ionic bond character, covalent bond of ionic bond, covalent bond, bond parameters, lewis structure, polar character of covalent bond, VSEPR theory, geometry of covalent molecules, valence bond theory, concept of hybridisation involving s, p and d orbitals and shapes of some simple molecules. Coordinate bond. Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only). Resonance and hydrogen bond.

(i) *Kossel-Lewis approach to chemical bonding. Octet rule, its application to electrovalent and covalent bonds.*

(ii) *Electrovalent or ionic bond: Lewis structures of NaCl, Li<sub>2</sub>O, MgO, CaO, MgF<sub>2</sub>, and Na<sub>2</sub>S.*

*Definition of ionic bond.*

*The conditions necessary for the formation of ionic bonds such as:*

- *low ionisation enthalpy of metals.*
- *high electron gain enthalpy of non-metals.*
- *high lattice energy.*
- *electronegativity difference between the reacting atoms.*

*All these points must be discussed in detail.*

*The formation of cations and anions of elements and their positions in the periodic table.*

*Variable electrovalency; reasons for variable electrovalency i.e. due to inert electron pair effect and unstable core, by using suitable examples.*

*Calculation of lattice enthalpy (Born-Haber cycle).*

*Characteristics of electrovalent bond.*

(iii) *Covalent Bond – Bond parameters, Lewis structure, polar character of covalent bond, shapes.*

*Sigma and pi bonds e.g. formation of ammonia, nitrogen, ethene, ethyne, and carbon dioxide.*

*Definition of covalent bond, conditions for formation of covalent bonds, types of covalent bonds, i.e. single, double and triple bonds. Sigma and pi bonds: H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>.*

*Classification of covalent bonds based on electronegativity of atoms - polar and non-polar covalent bond, dipole moment.*

*Formation of CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>O, ethane, ethene, ethyne and CO<sub>2</sub>, etc. and their electron dot structure or Lewis structure.*

*Characteristics of covalent compounds.*

*Comparison in electrovalency and covalency.*

*Reason for variable covalency e.g. Phosphorus 3 & 5 and sulphur 2, 4, 6 & chlorine 1, 3, 5 and 7.*

*Formal charge of ions.*

(iv) *Deviation from octet rule and Fajan's rules.*

*Definition of octet rule.*

*Failure of octet rule, due to either incomplete octet or exceeding of octet with suitable examples.*

*Fajan's rules: statements, conditions for electrovalency and covalency. Polar and non polar bonds should be correlated with Fajan's rules.*

(v) *Valence Shell Electron Pair Repulsion (VSEPR) Theory; Hybridisation and shapes of molecules: hybridisation involving s, p and d orbitals only.*

*Concept of electron-pair repulsion and shapes of molecules using suitable examples.*

*Hybridisation and molecular shapes – definition, hybridisation of orbitals involving s, p and d orbitals (using suitable examples).*

(vi) *Molecular orbital theory: Qualitative treatment of homonuclear diatomic molecules of first two periods (hydrogen to neon), Energy level diagrams, bonding and antibonding molecular orbitals, bond order, paramagnetism of O<sub>2</sub> molecule. Relative stabilities of O<sub>2</sub>, O<sub>2</sub><sup>-</sup>, O<sub>2</sub><sup>2-</sup>, O<sub>2</sub><sup>+</sup> and N<sub>2</sub>, N<sub>2</sub><sup>+</sup>, N<sub>2</sub><sup>-</sup>, N<sub>2</sub><sup>2-</sup>.*

(vii) *Co-ordinate or dative covalent bond, e.g. formation of oxy-acids of chlorine: Co-ordinate or dative covalent bonding: definition, formation of chlorous acid, chloric acid, perchloric acid, ammonium ion, hydronium ion, nitric acid, ozone.*

(viii) *Resonance in simple inorganic molecules: Resonance in simple inorganic molecules like ozone, carbon dioxide, carbonate ion and nitrate ion.*

(ix) *Hydrogen bonding: the examples of hydrogen fluoride, water (ice), alcohol, etc. may be considered.*

*H-bonding – definition, types, condition for hydrogen bond formation, examples of inter-molecular hydrogen bonding in detail taking hydrogen fluoride, water and ice and ethanol into account. Intramolecular hydrogen bonding.*

## 5. States of Matter: Gases and Liquids

States of matter and their characteristic properties to establish the concept of the molecule. Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, Avogadro's number, ideal behaviour of gases and derivation of ideal gas equation. Kinetic Theory of gases, kinetic energy and molecular speeds (elementary idea). Deviation from ideal behaviour, van der Waal's equation, liquefaction of gases, critical temperature. Liquid state - vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

(i) *Intermolecular interactions (van der Waals forces), types of van der Waals forces, melting and boiling points.*

(ii) *The Gas Laws.*

*Boyle's law, Charles' law, Absolute temperature, pressure temperature law, Avogadro's law and Avogadro's constant. Relationship between the mole and Avogadro's number.*

*Simple numerical problems based on the above laws.*

*Dalton's law, Graham's law of diffusion.*

*Dalton's law of partial pressures and its application.*

*Graham's Law of diffusion and its application.*

*Numerical problems based on the above.*

(iii) *Ideal gas equation and application of this equation.*

*Ideal gas equation  $PV = nRT$ ; its application in calculation of relative molecular mass and in the calculation of the value of R.*

(iv) *Kinetic Theory of gases.*

*Characteristics of gases, comparison between solid, liquid and gas. Properties of gases on the basis of kinetic theory of gases.*

*Postulates of kinetic theory must be discussed to explain gas laws. Concept of average, root mean square and most probable velocities (numericals not required). Non ideal behaviour of gases i.e. deviation from ideal gas equation may be discussed at low and at high temperature and pressure.*

*van der Waals' equation  $(P + a/V^2)(V-b) = RT$  for one mole of a gas. (numericals not required). The pressure correction and volume correction may be explained. significance and units of 'a' and 'b' (van der Waals' constant). Liquefaction of gases, critical temperature.*

(v) *Liquid State - vapour pressure, viscosity and surface tension.*

*Qualitative idea only, no mathematical derivations*

## 6. Chemical Thermodynamics

(i) *Introduction, concepts, types of system, surroundings, extensive, intensive properties and state functions.*

*Types of system – ideal system, real system, isolated system, closed system, open system. Meaning of surroundings.*

*Properties of the system: macroscopic, intensive and extensive properties.*

*State of the system.*

*Main processes the system undergoes: reversible, irreversible, adiabatic, isothermal, isobaric, isochoric, cyclic.*

*Meaning of thermodynamic equilibrium. Meaning of thermodynamic process.*

- (ii) First Law of Thermodynamics and its significance, work, heat, internal energy, enthalpy ( $\Delta U$  or  $\Delta E$  and  $\Delta H$ ), heat capacity and specific heat. Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomisation, sublimation, phase transition, ionisation, solution and dilution.

*Meaning of: internal energy of the system, work done by the system, by the surroundings at constant temperature, heat absorbed by the system and by the surroundings at constant temperature.*

*The sign convention for change in internal energy, heat given out or gained, work done by the system or by the surroundings.*

*State function and path function - meaning with examples. Internal energy change, work done and heat absorbed in a cyclic process.*

*Internal energy change in an isolated system and in a non-isolated system. Total internal energy change of a system and surroundings. Mathematical statement of the first law.*

*Significance of first law of thermodynamics. Need for enthalpy – constant pressure or open vessel processes. Enthalpy - a thermodynamic property, state function. Mathematical form of enthalpy.*

*Heat - the energy in transit. Conditions for the transfer of heat. Limitations in conversion of heat into work. Condition at which heat transfer ceases, unit of heat.*

*Meaning of work, capacity to do work, types of work. Mathematical form of reversible work and irreversible work. Difference between the reversible and irreversible work done – graphically.*

*Relationship between  $C_v$  and internal energy change. Relationship between  $C_p$  and  $C_v$ .*

*Definitions of the following:*

*Heat of reaction: Heat of formation – standard heat of formation, Heat of solution, Heat of dilution, Heat of neutralization, Heat of combustion.*

*Constancy in the heat of neutralisation:*

*Experimental verification in case of strong acids and strong bases. Reason for that*

*observation – ionic neutralisation and the heat evolved.*

*Definition of Calorific value of a fuel.*

*Statement of Hess' Law and its application.*

*Problems based on Hess' Law.*

- (iii) Second Law of Thermodynamics and its significance, spontaneity of a chemical change; Entropy, Free Energy. Inadequacy of First Law and need for Second Law; Ideas about reversible (recapitulation), spontaneous and non-spontaneous processes

*Meaning of entropy – derived from Second Law – statement of Second Law in terms of entropy; Physical significance of entropy;*

*State function and not path function. Entropy change of the universe, reversible isothermal process and irreversible process.*

*Meaning of thermal death, Gibb's free energy of the system and Helmholtz free energy. Relationship between Gibb's free energy and Helmholtz's free energy.*

*Relationship between change in Gibb's free energy and equilibrium constant of a chemical reaction. Defining the criteria for spontaneity of a chemical change in terms of Gibb's free energy.*

*Note: Numericals based on the First Law, Second Law of Thermodynamics and Hess' Law.*

- (iv) Third Law of Thermodynamics – statement only.

*Self-explanatory.*

## **7. Equilibrium**

- (i) Chemical Equilibrium.

Introduction of physical and chemical equilibrium and its characteristics

Dynamic nature of equilibrium, law of mass action, equilibrium constant and factors affecting equilibrium. Le Chatelier's principle and its applications.

*Irreversible and reversible reactions.*

*Physical equilibrium: solid-liquid, liquid-vapour, solid-vapour; Characteristics of Physical equilibrium.*

*Chemical equilibrium: Characteristics of chemical equilibrium; dynamic nature. Law of mass action; Equilibrium constant in terms of concentration  $K_c$ . Gaseous reactions; Equilibrium constant in terms of partial pressures  $K_p$ . Relationship between  $K_p$  and  $K_c$  (derivation required); Characteristics of equilibrium constant; Units for equilibrium constant; Simple calculations of equilibrium constant and concentration.*

*The following examples should be considered to show maximum yield of products:*

- *Synthesis of ammonia by Haber's process.*
- *The dissociation of dinitrogen tetra oxide.*
- *Hydrolysis of simple esters.*
- *The contact process for the manufacture of sulphuric acid.*

*Le Chatelier's Principle. Statement and explanation.*

*Factors affecting chemical and physical equilibria should be discussed in the light of Le Chatelier's principle.*

- *Change of concentration.*
- *Change of temperature.*
- *Change of pressure.*
- *Effect of catalyst.*
- *Addition of inert gas.*

## (ii) Ionic equilibrium

*Introduction, electrolyte (strong and weak), non-electrolyte, ionisation, degree of ionisation of polybasic acids, acid strength, concept of pH, pH indicators, buffer solution, common ion effect (with illustrative examples). Henderson equation, hydrolysis of salts, solubility and solubility product.*

*Ostwald's dilution law and its derivation. Strength of acids and bases based on their dissociation constant. Problems based on the Ostwald's dilution law.*

*Arrhenius, Brønsted-Lowry and Lewis concept of acids and bases, multistage ionisation of acids and bases with examples.*

*Ionic product of water – definition, pH, pOH,  $pK_w$  of solutions.*

*pH indicators and their choice in titrimetry.*

*Numericals on the above concepts.*

*Common ion effect – definition, examples (acetic acid and sodium acetate; ammonium hydroxide and ammonium chloride), applications in salt analysis.*

*Salt hydrolysis – salts of strong acids and weak bases, weak acids and strong bases, weak acids and weak bases and the pH formula of the solutions of these salts in water with suitable examples.*

*Buffer solutions: definition, examples, action; its interpretations based on Le Chatelier's principle. Henderson equation.*

*Solubility product: definition and application in qualitative salt analysis (Group II, III and IV cations).*

*Numericals on pH, buffer solutions, solubility and solubility product.*

## 8. Redox Reactions

*Concept of oxidation and reduction, redox reactions, oxidation number, change in oxidation number, balancing redox reactions (in terms of loss and gain of electrons). Applications of redox in various types of chemical reactions.*

- *Concept of oxidation and reduction in terms of oxygen, hydrogen, electrons.*
- *Redox reactions – examples.*
- *Oxidation number: rules for calculation, simple calculations of oxidation state in molecules and ions like  $K_2Cr_2O_7$ ,  $S_2O_3^{2-}$ , etc.*
- *Oxidation and reduction in terms of change in oxidation number.*
- *Balancing of redox reactions in acidic and basic medium by oxidation number and ion-electron method.*

## 9. Hydrogen

Hydrogen and its compounds: hydrides, water, heavy water, hydrogen peroxide.

*Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, hydrides (ionic covalent and interstitial); hydrogen as a fuel.*

*Physical and chemical properties of water, soft and hard water, and removal of hardness of water, heavy water.*

*Hydrogen peroxide:*

*Preparation from peroxide, structure, oxidising properties: reaction with KI, PbS, acidified FeSO<sub>4</sub>; reducing properties – reaction with acidified KMnO<sub>4</sub> and chlorine. Calculation of strength of hydrogen peroxide.*

## 10. s-Block Elements (Alkali and Alkaline Earth Metals)

(i) Group 1 and 2 elements

*General characteristics of Group 1 and 2 should include the following:*

*Occurrence; physical state; electronic configuration; atomic and ionic radii; common oxidation state; electropositive /electronegative character; ionisation enthalpy; reducing/oxidising nature; distinctive behaviour of first member of each group (namely Lithium, Beryllium); nature of oxides, hydroxides, hydrides, carbonates, nitrates; chlorides, sulphates.*

(ii) Preparation and properties of some important compounds.

Sodium chloride, sodium hydroxide, Sodium carbonate, sodium bicarbonate, sodium thiosulphate; biological importance of sodium and potassium.

Magnesium chloride hexahydrate, calcium oxide, calcium hydroxide, calcium carbonate, plaster of paris and cement. Industrial uses of the above, biological importance of magnesium and calcium.

*Group 1:*

- *Sodium chloride - uses.*
- *Sodium hydroxide - only the principle of preparation by Castner-Kellner cell. Uses.*

- *Sodium carbonate – principal and equation of Solvay’s process. Uses.*
- *Sodium bicarbonate - preparation from sodium carbonate. Uses.*
- *Sodium thiosulphate - preparation from sodium sulphite and its reaction with iodine, dilute acids and silver nitrate. Uses.*

*Group 2:*

- *Magnesium chloride hexahydrate - preparation from magnesium oxide. Effect of heat. Uses*
- *Calcium oxide - preparation from limestone; reaction with water, carbon dioxide and silica. Uses.*
- *Calcium hydroxide – preparation from calcium oxide and uses.*
- *Calcium carbonate – preparation from calcium hydroxide and uses.*
- *Plaster of Paris - preparation from gypsum. Uses.*
- *Manufacture of cement. Uses.*

## 11. Some p -Block Elements

(i) Group 13 Elements

*General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group, Boron - physical and chemical properties.*

(ii) Preparation and properties of some important compounds, borax, boric acid, boron hydrides, aluminium: Reactions with acids and alkalies. Lewis acid character of boron halides; amphoteric nature of aluminium, alums.

*Borax- reaction with water and action of heat on hydrated compound (preparation not required).*

*Borax Bead Test.*

*Diborane - Preparation properties, structure and uses.*

*Boric acid – preparation and action of heat.*

*Aluminium: Reactions with acids and alkalies.*

*Alums – preparation and uses.*

(iii) Group 14 Elements

*General characteristics, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements.*

*Carbon-catenation, allotropic forms. Structure of diamond graphite and fullerene; stability of +2 oxidation state down the group in terms of inert pair effect.*

(iv) Some important compounds; oxides of carbon and silicon, silicon carbide, silicon tetra chloride, silicones, silicates and zeolites.

*Preparation and properties of:*

*Carbon monoxide - preparation from incomplete combustion of carbon. Hazards of CO. Reducing nature of CO.*

*Carbon dioxide - preparation from limestone and carbon, limewater test. Uses.*

*Silicon dioxide - structure, comparison with carbon dioxide. Uses.*

*Silicon carbide - preparation from silica. Uses.*

*Silicon tetra chloride - preparation from silicon and uses.*

*Silicones - general method of preparation. Uses.*

*Silicates – structure and uses.*

*Zeolites – formula and use.*

## 12. Organic Chemistry - Some Basic Principles and Techniques

General introduction, classification and IUPAC nomenclature of organic compounds and isomerism.

Methods of purification, qualitative and quantitative analysis. Electron displacement in a covalent bond: inductive effect, electromeric effect, resonance and hyperconjugation.

Homolytic and heterolytic bond fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

(i) Introduction to organic chemistry:

*Vital force theory, reason for separate study of organic chemistry and its importance, characteristics of carbon atoms (tetra valency),*

*Reasons for large number of organic compounds: catenation, isomerism and multiple bonding, etc.*

(ii) Classification of organic compounds: (definition and examples): open chain, closed chain, homocyclic, heterocyclic, aromatic, alicyclic compounds, homologous series and its characteristics, functional groups.

(iii) IUPAC rules for naming organic compounds. Aliphatic, alicyclic and aromatic compounds.

(iv) Definition and classification of isomerism:

*Structural isomerism: definition, classification, examples.*

*Chain isomerism, Positional isomerism, Functional isomerism, Metamerism, Tautomerism - examples for each of the above.*

*Stereoisomerism: definition and classification, examples.*

*Geometrical isomerism: Definition. Conditions for compounds to exhibit geometrical isomerism; types and examples, cis and trans, syn and anti. Examples.*

*Optical isomerism: Definition, Nicol prism, plane polarised light. polarimeter. Method of measuring angle of rotation. Specific rotation. Conditions for optical activity. d, l form; External compensation, Internal compensation, racemic mixture & meso form. Examples – lactic acid and tartaric acid.*

(v) Analysis of organic compounds:

*Detection of elements (qualitative analysis) such as carbon, hydrogen, nitrogen, halogens and sulphur should be considered by using Lassaigne's test and reactions involved in it.*

(vi) Estimation of carbon, hydrogen, nitrogen, halogens, sulphur and phosphorous:

*Estimation of carbon and hydrogen – Leibig's method.*

*Estimation of nitrogen - Kjeldahl's method.*

*Estimation of halogens sulphur and phosphorous - Carius method. Numericals included. Experimental details required.*

(vii) Types of chemical reactions and their mechanisms.

*Substitution, addition, elimination reactions: definition and examples.*

*Homolytic and heterolytic fission – definition and examples. Free radicals, carbocation, carbanion (their reactivities and stabilities).*

*Electrophiles and nucleophiles – definition and examples (including neutral electrophiles and nucleophiles).*

*Inductive, electromeric, mesomeric effect and hyperconjugation – definition, examples.*

(viii) *Free radicals and polar mechanisms*

*In terms of fission of the bonds and formation of the new bonds including  $S_N1$ ,  $S_N2$ ,  $E_1$  and  $E_2$  mechanisms. Explain with relevant examples and conditions.*

### 13. Hydrocarbons

#### Classification of Hydrocarbons

##### I. Aliphatic Hydrocarbons

(i) Alkanes - Nomenclature, isomerism, conformation (methane and ethane), physical properties, chemical properties including free radical mechanism of halogenation, combustion and pyrolysis.

*Occurrence, conformation (Sawhorse and Newman projections of ethane).*

*General methods of preparation: from sodium salts of carboxylic acids (decarboxylation and Kolbe's electrolytic method); from alcohols and alkyl halides (Wurtz reaction, Coreyhouse Synthesis). From aldehydes and Grignard's Reagent.*

*Physical and chemical properties of alkanes.*

*Physical properties: state, freezing point, melting point, boiling point, density.*

*Chemical properties: combustibility, reaction with chlorine (free radical mechanism), reaction with oxygen in presence of catalyst (formation of alcohol, aldehyde, and carboxylic acid). Cyclisation, aromatisation, isomerisation and pyrolysis.*

*Uses of alkanes.*

(ii) Alkenes - Nomenclature, structure of double bond (ethene), isomerism; methods of preparation; physical properties, chemical properties; addition of hydrogen, halogen, water, hydrogen halides

(Markownikoff's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

*General methods of preparation – dehydration of alcohols, dehydrohalogenation of alkyl halides (from vicinal dihalides), Kolbe's electrolytic method and from alkynes.*

*Physical Properties: State, freezing point, melting point, boiling point, dipole moment, density.*

*Chemical properties - addition reactions (hydrogen, halogens, hydrogen halides, sulphuric acid, water).*

*Markownikoff's rule and anti-Markownikoff's rule with mechanism and examples.*

*Oxidation: complete combustion, hot and cold alkaline  $KMnO_4$  (Baeyer's reagent), ozonolysis.*

*Polymerisation.*

*Saytzeff's rule and its application.*

*Uses of alkenes.*

(iii) Alkynes - Nomenclature, structure of triple bond (ethyne), methods of preparation; physical properties, chemical properties: acidic character of alkynes, addition reactions - hydrogen, halogens, hydrogen halides and water.

*General methods of preparations of alkynes. Manufacture of ethyne by calcium carbide and from natural gas. Dehydrohalogenation and Kolbe's electrolytic method.*

*Physical properties of alkynes: State of existence, freezing point, melting point, boiling point, density.*

*Chemical properties of alkynes – addition reactions (hydrogen, halogens, hydrogen halides and water), acidic nature of alkynes, formation of acetylides.*

*Oxidation: complete combustion, hot and cold alkaline  $KMnO_4$  (Baeyer's reagent), ozonolysis.*

*Polymerisation.*

*Uses of alkynes.*

*Distinguishing test between Alkane, Alkene and Alkyne.*



## II. Aromatic Hydrocarbons

Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Crafts alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

*Structure: Resonance structures (Kekule's) of benzene.*

*Benzene: Preparation from sodium benzoate and from phenol.*

*Physical properties: State of existence, freezing point, melting point, boiling point, density.*

*Chemical properties:*

- *Electrophilic substitution reactions with mechanism (halogenation, nitration, sulphonation).*
- *Alkylation, acetylation – Friedel Crafts reaction.*
- *Directive influence (o-, p-, and m-) of substituents in electrophilic and nucleophilic substitutions (with mechanism).*
- *Oxidation: catalytic oxidation, reaction with ozone.*
- *Addition reactions with hydrogen, chlorine, bromine.*
- *Pyrolysis (formation of bi-phenyl).*

*Carcinogenicity and toxicity of benzene may be discussed.*

*Uses.*

## 14. Environmental Chemistry

Types of environmental pollution (air, water and soil pollution); various types of pollutants: smog, acid rain; effects of depletion of ozone layer, greenhouse effect and global warming. Pollution due to industrial wastes, green chemistry as an alternative tool for reducing pollution; strategies for control of environmental pollution.

*Gaseous pollutants: oxides of nitrogen, carbon, sulphur, hydrocarbons; their sources, harmful effects and prevention; Greenhouse effect and global warming; acid rain;*

*Particulate pollutants: smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.*

*Water pollutants: pathogens, organic waste, chemical pollutants; their harmful effects and prevention.*

*Soil Pollutants: pesticides, herbicides. Green chemistry as an alternative tool for reducing pollution.*

## PAPER II

### PRACTICAL WORK- 15 Marks

**Candidates are required to complete the following experiments:**

1. Basic laboratory techniques:

- Cutting a glass tube.
- Bending a glass tube.
- Drawing out a glass jet.
- Boring a cork.

2. Titration: acid-base titration involving molarity.

*Titrations involving:*

- *Sodium carbonate solution/ dil H<sub>2</sub>SO<sub>4</sub> or dil. HCl using methyl orange indicator.*
- *NaOH or KOH solution/ dil H<sub>2</sub>SO<sub>4</sub> or dil. HCl using methyl orange indicator.*
- *Calculations involving molarity, concentration in grams L<sup>-1</sup>/ number of ions, water of crystallisation and percentage purity.*

**NOTE: Calculation of molarity must be upto 4 decimal places at least, in order to avoid error.**

### OBSERVATION TABLE

S. No.	(A)	(B)	(B – A)
	Initial burette reading (ml)	Final burette reading (ml)	Difference (ml)
1			
2			
3			

- Concordant reading is to be used for titre value. Concordant reading is two consecutive values which are exactly the same. Average will not be accepted as titre value.
- The table is to be completed in ink only. Pencil is not to be used.
- Overwriting will not be accepted in the tabular column.

**Observations:**

- Pipette size (should be same for all the candidates at the centre):
  - Titre value (concordant).
3. Qualitative analysis: identification of single salt containing one anion and one cation:

Anions:  $\text{CO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{PO}_4^{3-}$ .

Cations:  $\text{NH}_4^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ .

Anions: Dilute acid group –  $\text{CO}_3^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$

Concentrated Acid Group –  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{CH}_3\text{COO}^-$ .

Special Group -  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ .

Cations: Group Zero:  $\text{NH}_4^+$

Group I:  $\text{Pb}^{2+}$

Group II:  $\text{Cu}^{2+}$ ,  $\text{Pb}^{2+}$

Group III:  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$

Group IV:  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$

Group V:  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$

Group VI:  $\text{Mg}^{2+}$

**NOTE:**

- For wet test of anions, sodium carbonate extract must be used (except for carbonate).

- **Chromyl chloride test not to be performed.**

**(Insoluble salts, such as lead sulphate, barium sulphate, calcium sulphate, strontium sulphate should not be given).**

4. Preparation of inorganic compounds.

(a) Preparation of potash alum/Mohr's salt.

(b) Preparation of crystalline  $\text{FeSO}_4/\text{CuSO}_4$ .

5. Paper Chromatography.

Preparation of chromatogram, separation of pigments from extracts of leaves and flowers/ink mixtures; determination of  $R_f$  value.

**PROJECT WORK AND PRACTICAL FILE -**

**15 Marks**

**Project Work – 10 Marks**

The candidate is to creatively execute one project/assignment on a selected topic of Chemistry. Teachers may assign or students may choose **any one** project of their choice. (Refer to the suggested topics at the end of Class XII syllabus).

**Suggested Evaluation criteria for Project Work:**

▪ Introduction / purpose
▪ Contents
▪ Analysis/ material aid (graph, data, structure, pie charts, histograms, diagrams, etc)
▪ Presentation
▪ Bibliography

**Practical File – 5 Marks**

Teachers are required to assess students on the basis of the Chemistry Practical file maintained by them during the academic year.

## CLASS XII

There will be two papers in the subject:

**Paper I: Theory** - 3 hours ... 70 marks

**Paper II: Practical:** 3 hours ... 15 marks

Project Work ... 10 marks

Practical File ... 5 marks

### PAPER I (THEORY) - 70 Marks

There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.

S.No.	UNIT	TOTAL WEIGHTAGE
1.	Solid State	<b>Physical Chemistry</b> <b>25 Marks</b>
2.	Solutions	
3.	Electrochemistry	
4.	Chemical Kinetics	
5.	Surface Chemistry	
6.	General Principles and Processes of Isolation of Elements	<b>Inorganic Chemistry</b> <b>20 Marks</b>
7.	p -Block Elements	
8.	d -and f -Block Elements	
9.	Coordination Compounds	
10.	Haloalkanes and Haloarenes	<b>Organic Chemistry</b> <b>25 Marks</b>
11.	Alcohols, Phenols and Ethers	
12.	Aldehydes, Ketones and Carboxylic Acids	
13.	Organic Compounds containing Nitrogen	
14.	Biomolecules	
15.	Polymers	
16.	Chemistry in Everyday Life	
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I –THEORY – 70 Marks

### 1. Solid State

Solids: their classification based on different binding forces such as: ionic, covalent molecular; amorphous and crystalline solids (difference), metals. Type of unit cell in two dimensional and three dimensional lattices, number of atoms per unit cell (all types). Calculation of density of unit cell, packing in solids, packing efficiency, voids, point defects, electrical and magnetic properties.

Band theory of metals. Conductors, semiconductors ( $n$  and  $p$  type) and insulators.

- (i) *Crystalline and amorphous solids.*
- (ii) *Definition of crystal lattice, unit cell; types of unit cell (scc, fcc, bcc); calculation of the number of atoms per unit cell; relationship between radius, edge length and nearest neighbour distance. Calculation of density of unit cell, formula of the compound – numericals based on it; packing in 3 – D, packing fraction in scc, fcc, bcc with derivation; voids – types, location, formation (derivation of radius of voids).*
- (iii) *Characteristics of crystalline solids; ionic (NaCl), metallic (Cu), atomic (diamond and graphite).*
- (iv) *Point defects: Stoichiometric, non-stoichiometric and impurity defects (F- centres).*
- (v) *Electrical properties: Conductors, semiconductors ( $n$  &  $p$  types) and insulators (Band Theory), piezoelectricity and pyroelectricity.*
- (vi) *Magnetic properties: diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and antiferromagnetic.*

### 2. Solutions

Study of concentration of solutions of solids in liquids, liquid in liquid, solubility of gases in liquids, solid solutions, Colligative properties - Raoult's law of relative lowering of vapour pressure (1<sup>st</sup> & 2<sup>nd</sup>), elevation of boiling point, depression of freezing point, osmotic pressure. Use of colligative properties in determining molecular masses of solutes, abnormal molecular mass association and dissociation, van't Hoff factor.

*Normality, molality, molarity, mole fraction, ppm, as measures of concentration. Definition of the above with examples. Simple problems based on the above.*

- (i) *Solubility of gases in liquids – Henry's Law, simple numericals based on the above.*
- (ii) *Raoult's Law for volatile solutes and non-volatile solutes, ideal solution, non-ideal solution. Azeotropic mixtures – definition, types, graphical representation, fractional distillation with examples.*
- (iii) *Colligative properties – definition and examples, and its use in determination of molecular mass.*
  - (a) *Relative lowering of vapour pressure: Definition and mathematical expression of Raoult's Law. Determination of relative molecular mass by measurement of lowering of vapour pressure.*
  - (b) *Depression in freezing point: molal depression constant (cryoscopic constant) – definition and mathematical expression (derivation included).*
  - (c) *Elevation in boiling point method: molal elevation constant (ebullioscopic constant) definition and mathematical expression (derivation included).*
  - (d) *Osmotic pressure: definition and explanation. Natural and chemical semipermeable membranes, reverse osmosis, isotonic, hypotonic and hypertonic solutions. Comparison between diffusion and osmosis. Application of osmotic pressure in the determination of relative molecular mass.*

*van't Hoff- Boyle's Law, van't Hoff – Charles' Law, van't Hoff - Avogadro's law.*
- (e) *Abnormal molecular mass: Dissociation and Association with suitable examples*
- (f) *van't Hoff factor for the electrolytes which dissociate and the molecules which associate in solution. Modification of the formula of colligative properties based on van't Hoff factor. Simple problems. Calculation of degree of dissociation and association. Experimental details not required.*

***Numerical problems based on all the above methods. Experimental details not required.***

### 3. Electrochemistry

Electrolytic and electrochemical cells. Redox reactions in electrochemical cells. Electromotive Force (emf) of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and emf of a cell.

Conductance in electrolytic solutions, specific, equivalent and molar conductivity, variations of conductivity with concentration, graphs; Kohlrausch's Law of electrolysis and Faraday's Laws of electrolysis. Dry cell and lead accumulator, fuel cells, corrosion.

- (i) *Electrochemical cells: introduction, redox reactions (principle of oxidation and reduction in a cell).*
- (ii) *Galvanic cells - introduction; representation, principle – oxidation reduction. Mechanism of production of electric current in a galvanic cell.*
- (iii) *Measurement of potential. Single electrode potentials.*  
*Standard hydrogen electrode ( $E^\circ$ ) - definition, preparation, application and limitations.*  
*Standard electrode potential - Measurement of standard electrode potential of  $Zn^{++}/Zn$ ,  $Cu^{++}/Cu$ , half cell (using standard hydrogen electrode).*  
*Cell notation – representation.*  
*Factors affecting electrode potential with explanation - main emphasis on the temperature, concentration and nature of the electrode.*
- (iv) *Electrochemical series. Its explanation on the basis of standard reduction potential.*  
*Prediction of the feasibility of a reaction.*
- (v) *Nernst equation and correlation with the free energy of the reaction with suitable examples.*  
*Prediction of spontaneity of a reaction based on the cell emf.*  
*Numericals on standard electrode potential of half-cells, cell emf, relationship between free energy and equilibrium constant, standard electrode potential and free energy.*

- (vi) *Comparison of metallic conductance and electrolytic conductance. Relationship between conductance and resistance. Specific resistance and specific conductance.*

*Cell constant: Calculation of cell constant. Meaning of equivalent conductance. Meaning of molar conductance. General relationship between specific conductance, molar conductance and equivalent conductance (units and graphs).*

*Units, numericals.*

*Molar conductance of a weak electrolyte at a given concentration and at infinite dilution. Kohlrausch's Law – definition, applications and numericals.*

- (vii) *Faraday's laws of Electrolysis.*

*Faraday's First Law of electrolysis. Statement, mathematical form. Simple problems.*

*Faraday's Second Law of electrolysis: Statement, mathematical form. Simple problems.*

*Relation between Faraday, Avogadro's number and charge on an electron.  $F = N_A e$  should be given (no details of Millikan's experiment are required).*

- (viii) *Batteries: Primary and Secondary Cells: Leclanche cell, mercury cell, Lead storage battery and fuel cell – structure, reactions and uses.*
- (ix) *Corrosion: Concept, mechanism of electrochemical reaction, factors affecting it and its prevention.*

### 4. Chemical Kinetics

Meaning of Chemical Kinetics – slow and fast reactions. Rate of a reaction - average and instantaneous rate (graphical representation). Factors affecting rate of reaction: surface area, nature of reactants, concentration, temperature, catalyst and radiation. Order and molecularity of a reaction, rate law and specific rate constant. Integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment). Concept of threshold and activation energy, Arrhenius equation.

- (i) *Meaning of chemical kinetics, Scope and importance of Kinetics of the reaction, slow and fast reactions – explanation in terms of bonds.*
- (ii) *Rate of Reaction: definition, representation of rate of reaction in terms of reactants and products, determination of rate of reactions graphically, instantaneous and average rate of reaction. Factors affecting rate of reaction.*
- (iii) *Law of mass Action: statement and meaning of active mass. Explanation with an example – general reactions.*
- (iv) *Effect of concentration of reactants on the rate of a reaction: Qualitative treatment, based on the law of mass Action, statement of rate law, General rate equation –  $\text{Rate} = k(\text{concentration of the reactant})^n$ , where  $k$  is rate constant and  $n$  is the order of the reaction, relationship between the rate of the reaction with rate constant with respect to various reactants.*
- (v) *Order of a reaction: meaning, relation between order and stoichiometric coefficients in balanced equations, order as an experimental quantity, rate equation for zero order reaction and its unit, mathematical derivation of rate equation for first order reaction, characteristics of first order reaction – rate constant is independent of the initial concentration, units to be derived, definition of half-life period, derivation of expression of half-life period from first order rate equation.*
- Problems based on first order rate equation and half-life period.*
- (vi) *Molecularity of the reaction: Meaning – physical picture, Relation between order, molecularity and the rate of a reaction, Differences between order and molecularity of a reaction.*
- (vii) *The concept of energy: Exothermic and endothermic reactions, concept of energy barrier, threshold and activation energy, formation of activated complex, effect of catalyst on activation energy and reaction rate.*
- (viii) *Collision Theory: Condition for a chemical change – close contact, particles should collide. Collisions to be effective – optimum energy and proper orientation during collision. Energy barrier built-up when the collision is about to take place, Activated complex formation, difference in energy of the reactant and the product – exothermic and endothermic reactions with proper graphs and labelling.*
- (ix) *Mechanism of the reaction: meaning of elementary reaction, meaning of complex and overall reaction, explanation of the mechanism of the reaction, slowest step of the reaction. Relationship between the rate expression, order of reactants and products at the rate-determining step, units of rate constant – explanation with suitable examples.*
- (x) *Effect of temperature on the rate constant of a reaction: Arrhenius equation –  $K = Ae^{-E_a/RT}$ , Meaning of the symbols of Arrhenius equation, related graph, evaluation of  $E_a$  and  $A$  from the graph, meaning of slope of the graph, conversion from exponential to log form of the equation, relationship between the increase in temperature and the number of collisions. Numerical based on Arrhenius equation.*

## 5. Surface Chemistry

Absorption and Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids and liquids. Catalysis; homogenous and heterogenous, activity and selectivity, enzyme catalysis.

Colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multi-molecular, macromolecular and associated colloids; properties of colloids; Brownian movement, Tyndall effect, coagulation and electrophoresis. Emulsion - types of emulsions.

- (i) *Difference between absorption and adsorption: definition of physisorption and chemisorption and their differences.*

*Factors affecting adsorption of gases on solids, Freundlich adsorption isotherms, graph, expression and application of adsorption.*

(ii) *Catalysis: definition, types of catalysts – positive and negative, homogeneous and heterogeneous catalyst based on the state of the reactant and the catalyst, Elementary treatment of intermediate compound formation theory with examples; adsorption Theory, effect of catalyst on the rate of reaction – the change in the energy of activation in the activation energy curve. Characteristics of a catalyst; specificity, activity, surface area of a catalyst. Promoter and poison. Enzyme catalysis – basic idea and lock and key mechanism.*

(iii) *Colloidal State: Thomas Graham classified the substances as crystalloid and colloid, classification of substances on the basis of the particle size i.e. true solution, sol and suspension, colloidal system is heterogeneous. lyophilic and lyophobic colloid; classification of colloidal solutions as micro, macro and associated colloids.*

*Preparation of lyophilic colloids. Preparation of lyophobic colloids by colloid mill, peptization, Bredig's arc method, oxidation, reduction, double decomposition and exchange of solvent method, purification of colloids (dialysis, ultra-filtration, and ultracentrifugation).*

*Properties of colloidal solutions: Brownian movement, Tyndall effect, coagulation, electrophoresis (movement of dispersed phase), Protection of colloids, Gold number and Hardy-Schulze rule. Emulsions, surfactants, micelles (only definition and examples).*

*Application of colloids and emulsions in daily life.*

## 6. General Principles and Processes of Isolation of Elements

Metals: metallurgy, ores, principles and methods of extraction - concentration, oxidation, reduction, electrolytic refining. Occurrence and principles of extraction of aluminium, copper, zinc, iron and silver.

(i) *Definition of minerals, ores and metallurgy; principle ores of aluminium, iron, copper, zinc and silver.*

*Methods of concentration of ores: hydraulic washing, magnetic separation, froth floatation method, leaching.*

*Extraction of metal from concentrated ore – calcination, roasting and thermal reduction.*

*Thermodynamic principle of metallurgy - Gibb's energy (Ellingham diagram – significance only).*

*Metallurgy of aluminium, iron, copper, zinc and silver.*

*Refining of metals - distillation, liquation, electrolysis, vapour phase refining (nickel), zone refining.*

(ii) *Uses of metals and their alloys.*

## 7. p-Block Elements

### Group-15 Elements

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties. Nitrogen: preparation properties and its uses; compounds of nitrogen: oxides of nitrogen. Ammonia and nitric acid – preparation and properties. Phosphorus - allotropic forms, compounds of phosphorus: preparation and properties of phosphine, halides and oxoacids.

(i) *General introduction, electronic configuration, occurrence, oxidation states. Trends in physical properties; chemical properties with hydrogen, oxygen and halogens.*

(ii) *Nitrogen - Laboratory preparation, decomposition (ammonium dichromate, barium azide). Properties and uses.*

(iii) *Oxides of nitrogen ( $N_2O$ ,  $NO$ ,  $N_2O_3$ ,  $N_2O_4$ ,  $N_2O_5$ ) - preparation, structure and uses.*

(iv) *Ammonia – Preparation and manufacture. Properties: reaction with oxygen, copper oxide, chlorine, hydrochloric acid, formation of complexes. Uses.*

(v) *Nitric Acid - Preparation and manufacture. Properties: reaction with copper (dilute and concentrated  $HNO_3$ ), carbon and sulphur. Uses.*

- (vi) *Allotropes of phosphorus and their structures.*

*Phosphine – preparation from phosphorus and properties: reaction with halo acids).*

*Phosphorus trichloride - Preparation from phosphorous. Uses.*

*Phosphorus pentachloride - preparation from  $\text{PCl}_3$ . Thermal dissociation and hydrolysis. Uses, properties.*

*Oxoacids of phosphorus (structures and preparation only).*

### **Group-16 Elements**

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties. Oxygen: methods of preparation, properties and uses, classification of oxides. Ozone – methods of preparation. Sulphur -allotropic forms. Compounds of sulphur: preparation, properties and uses of sulphur-dioxide, sulphuric acid (industrial process of manufacture). Oxoacids of sulphur (structures only).

- (i) *Electronic configuration, oxidation states, occurrence. Trends in physical properties; chemical properties with hydrogen, oxygen and halogens.*
- (ii) *Oxygen – lab method of preparation, formation of oxides with metals and non-metals and their common nature.*
- (iii) *Ozone: manufacture by Siemen's ozoniser, thermal decomposition of ozone, its oxidising nature – reaction with lead sulphide, potassium iodide and mercury, its uses.*
- (iv) *Sulphur: allotropes of sulphur - rhombic, monoclinic, structure of sulphur and action of heat; extraction by Frasch process.*
- (v) *Sulphur dioxide: laboratory and industrial preparation from sulphites and sulphide ores, reaction of sulphur dioxide with  $\text{NaOH}$ ,  $\text{Cl}_2$ ,  $\text{KMnO}_4$  and structure of  $\text{SO}_2$ .*
- (vi) *Oxoacids of sulphur: structures only.*

*Sulphuric Acid: manufacture by Contact Process (equations, conditions and diagram), properties - acidic nature, mode of dilution, oxidising action, dehydrating nature and uses of sulphuric acid in industry.*

### **Group-17 Elements**

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties; Preparation, properties and uses of chlorine and hydrochloric acid. Compound of halogen, oxoacids of halogens (structures only), Interhalogen compounds.

- (i) *General introduction, electronic configuration, oxidation states. Trends in physical properties and chemical properties (hydrogen, oxygen, halogens and metals).*
- (ii) *Chlorine – preparation from  $\text{MnO}_2$  and  $\text{HCl}$ , from  $\text{NaCl}$ ,  $\text{MnO}_2$  and conc.  $\text{H}_2\text{SO}_4$  (only equations), reactions of chlorine with  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ , cold, dilute  $\text{NaOH}$  and hot, concentrated  $\text{NaOH}$ .*
- (iii) *Hydrochloric acid: Lab preparation, its acidic nature, reaction with ammonia, carbonates and sulphites, formation of aqua regia and its uses.*
- (iv) *Oxoacids of halogens: structures and acidic property.*
- (v) *Interhalogen compounds – structure, hybridisation and shapes:  $\text{XX}'$ ,  $\text{XX}'_3$ ,  $\text{XX}'_5$ ,  $\text{XX}'_7$ .*

### **Group-18 Elements**

Position in the periodic table, occurrence, electronic configuration, trends in physical and chemical properties, inert nature, uses.

- (i) *General introduction, electronic configuration, occurrence, trends in physical; chemical properties, state and low reactivity.*
- (ii) *Formation of xenon compounds with fluorine and oxygen (equations only), hybridisation, shape and structure of compounds.*
- (iii) *Uses of noble gases.*



## 8. d and f Block Elements

Position in the periodic table, occurrence, electronic configuration and characteristics of transition metals, general trends in properties of the 3d-series of transition metals - metallic character, ionisation enthalpy, oxidation states, ionic radii, colour of ions, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of  $K_2Cr_2O_7$  and  $KMnO_4$ .

Lanthanoids and actinoids.

### (i) d-Block: 3d, 4d and 5d series

*Study in terms of metallic character, atomic and ionic radii, ionisation enthalpy, oxidation states, variable valency, formation of coloured compounds, formation of complexes, alloy formation.*

### (ii) f-Block: 4f and 5f series

*Electronic configuration, atomic and ionic radii, oxidation states, formation of coloured compounds, formation of complexes, alloy formation. Lanthanoid contraction and its consequences. Chemical reactivity – with oxygen, hydrogen, halogen, sulphur, nitrogen, carbon and water.*

*Actinoids - oxidation states and comparison with lanthanoids.*

### (iii) Potassium permanganate: structure, shape, equation of extraction from pyrolusite ore, its oxidising nature in acidic, basic and neutral medium, use in redox titration.

*Oxidising nature in acidic [ $FeSO_4$ ,  $(COOH)_2 \cdot 2H_2O$ , KI], basic (KI) and neutral ( $H_2S$ ) mediums to be done.*

### (iv) Potassium dichromate: structure, shape, equation of extraction from chromite ore and its use in titration. Oxidising nature in acidic, basic and neutral medium, use in redox titration. Interconversion of chromate and dichromate ion (effect of pH).

## 9. Coordination Compounds

Concept of complexes, definition of ligands, coordination number, oxidation number. IUPAC nomenclature of mononuclear coordination compounds. Isomerism (structural and stereo).

Bonding, Werner's theory, VBT and CFT. Colour, magnetic properties and shapes. Importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

(i) *Definition of coordination compounds / complex compounds, differences with a double salt, study of ligands – mono-, bi-, tri-, tetra-, penta-, hexa- and polydentate, chelating ligands, definition of coordination number, its calculation for a complex coordination sphere, study of oxidation state of an element in a complex, its calculation, IUPAC rules of nomenclature of coordination compounds.*

(ii) *Isomerism – structural, stereo types and examples.*

(iii) *Valence bond theory of coordination compounds – examples of formation of inner orbital and outer orbital complexes (high and low spin, octahedral, tetrahedral and square planar), prediction of magnetic character.*

(iv) *Crystal field theory – crystal field splitting in tetra and octahedral systems. Explanation of colour and magnetic character.*

(v) *Stability of coordination compounds (explain stability on the basis of magnitude of K) as mentioned above).*

(vi) *Importance and uses.*

## 10. Haloalkanes and Haloarenes.

**Haloalkanes:** General formula, nomenclature and classification. Nature of C–X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

**Haloarenes:** Basic idea, nature of C–X bond, substitution reactions (directive influence of halogen in monosubstituted compounds only).

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons and DDT.

*Nature of C-X bond*

*Naming the halogen derivatives of alkanes by using common system and IUPAC system for mono-, di- and tri-halo derivatives.*

*Preparation of haloalkanes from:*

- Alkane and halogen.
- Alkene and hydrogen halide.
- Alcohols with  $PX_3$ ,  $PCl_5$  and  $SOCl_2$ .
- Halide exchange method (Finkelstein and Swarts)
- Silver salt of fatty acids (Hunsdiecker).

*Physical properties: State, melting point, boiling point and solubility.*

*Chemical properties: nucleophilic substitution reactions ( $S_N1$ ,  $S_N2$  mechanism in terms of primary, secondary and tertiary halides)*

*Reaction with: sodium hydroxide, water, sodium iodide, ammonia, primary amine, secondary amine, potassium cyanide, silver cyanide, potassium nitrite, silver nitrite, silver salt of fatty acid and lithium-aluminium hydride.*

*Elimination reaction (Saytzeff's rule) /  $\beta$  elimination.*

*Reaction with metals: sodium and magnesium (Wurtz's reaction, Grignard's reagent preparation).*

*Chloroform and iodoform: preparation and properties.*

*Structure of freons.*

*Preparation of haloarenes by Sandmeyer's and Gattermann's reaction, by electrophilic substitution.*

*Physical properties: State, melting point, boiling point and solubility.*

*Chemical properties:*

- Electrophilic substitution (chlorination nitration and sulphonation) with mechanism.
- Nucleophilic substitution (replacement of chlorine with  $-OH$ ,  $-NH_2$ ) with mechanism.
- Reduction to benzene.
- Wurtz-Fittig reaction.
- Fittig reaction.
- Addition reaction with magnesium (formation of Grignard reagent).
- Structure of DDT.

## 11. Alcohols, Phenols and Ethers

**Alcohols:** Classification, general formula, structure and nomenclature. Methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.

(i) *Classification into monohydric, dihydric and polyhydric alcohols, general formulae, structure and nomenclature of alcohols. Difference between primary, secondary and tertiary alcohols in terms of structure, physical properties and chemical properties.*

(ii) *Methods of preparation:*

- Hydration of Alkenes – direct hydration, indirect hydration, hydroboration oxidation.
- From Grignard's reagent.
- Hydrolysis of alkyl halides.
- Reduction of carbonyl compounds.
- From primary amines.

*Manufacture of methanol by Bosch process and ethanol by fermentation of carbohydrates, chemical equations required (only outline of the method of manufacture, detail not required).*

*Properties:*

- Acidic nature of alcohols:
- Reaction with sodium.
- Esterification with mechanism.
- Reaction with hydrogen halides.
- Reaction with  $PCl_3$ ,  $PCl_5$ , and  $SOCl_2$ .
- Reaction with acid chlorides and acid anhydrides
- Oxidation.
- Dehydration with mechanism.

*Uses of alcohols.*

(iii) *Conversion of one alcohol into another.*

(iv) *Distinction between primary, secondary and tertiary alcohols by Lucas' Test.*

**Phenols:** Classification and nomenclature. Methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

*Preparation of phenol from diazonium salt, chlorobenzene (Dow's process) and from benzene sulphonic acid.*

*Manufacture from Cumene.*

*Physical properties: state and solubility.*

*Chemical properties:*

- *Acidic character of phenol.*
- *Reaction with sodium hydroxide.*
- *Reaction with sodium.*
- *Reaction with zinc.*
- *Reaction with acetyl chloride and acetic anhydride.*
- *Reaction with phosphorus penta chloride.*
- *Bromination, nitration and sulphonation (Electrophilic substitution reactions).*
- *Kolbe's reaction (formation of salicylic acid).*
- *Reimer – Tiemann reaction*
- *Test for phenol – FeCl<sub>3</sub> test, azo dye test.*

**Aliphatic Ethers:** General formula, structure and nomenclature. Methods of preparation, physical and chemical properties, uses.

*Ethers: structure of ethereal group.*

*Preparation from alcohol (Williamson's synthesis).*

*Physical properties: state, miscibility.*

*Chemical properties:*

- *Reaction with chlorine.*
- *Oxidation (peroxide formation).*
- *Reaction with HI.*
- *Reaction with PCl<sub>5</sub>.*

### **Aryl ethers**

*Physical properties – state and solubility.*

*Chemical properties – preparation of anisole (Williamson's synthesis), electrophilic*

*substitution (halogenation, nitration and Friedel-Crafts reaction.)*

*Uses of ether.*

## **12. Aldehydes, Ketones and Carboxylic Acids**

**Aldehydes and Ketones:** Nomenclature, structure of methods of preparation of aldehydes and ketones, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes and uses.

*Preparation:*

- *From alcohol.*
- *From alkenes (ozonolysis).*
- *From alkynes (hydration).*
- *From acid chlorides (Rosenmund's reduction, reaction with dialkyl cadmium).*
- *From calcium salt of carboxylic acids.*
- *From nitriles (Stephen reaction, Grignard's reagent).*
- *From esters.*

*Physical properties – state and boiling point.*

*Chemical properties:*

- *Nucleophilic addition reactions with mechanism (ammonia and its derivatives, HCN, NaHSO<sub>3</sub> and Grignard's reagent).*
- *Oxidation reactions, iodoform reaction.*
- *Reduction: reduction to alcohol and alkanes (Clemmensen's reduction, Wolff-Kishner reduction, Red phosphorus and HI).*
- *Base catalysed reactions (with mechanism): Aldol condensation, cross Aldol condensation, Cannizzaro's reaction.*

*Tests: difference between formaldehyde and acetaldehyde; aldehydes and ketones.*

*Uses of aldehydes and ketones.*

### **Aromatic aldehyde (Benzaldehyde)**

*Lab preparation from toluene by oxidation with chromyl chloride.*

*Physical properties: state and stability.*

*Chemical properties:*

- Oxidation and reduction.
- Nucleophilic addition reaction (hydrogen cyanide and sodium bisulphite).
- Reactions with ammonia and its derivatives (hydroxyl amine, hydrazine and phenyl hydrazine).
- Reaction with phosphorus pentachloride.
- Cannizzaro reaction.
- Benzoin condensation.
- Perkin's reaction.
- Electrophilic substitution - halogenation, nitration and sulphonation.

*Test: distinction between aromatic and aliphatic aldehydes.*

*Uses of benzaldehyde.*

**Carboxylic Acids:** Classification, general formula and structure of carboxylic group. Nomenclature, acidic nature, methods of preparation, physical and chemical properties and uses.

*Classification of mono and di carboxylic acids with examples.*

*Preparation of aliphatic and aromatic carboxylic acid:*

- From alcohols, aldehydes.
- From nitriles.
- From Grignard's reagent.

*Physical properties: state, boiling point and solubility.*

*Chemical properties:*

- Acidic character: (aliphatic, aromatic carboxylic acids with the effect of substituents on the acidic character – to be dealt with in detail)
- Reaction with active metals, alkalies, carbonates and bicarbonates,
- Formation of acid derivatives.
- Decarboxylation (chemical and Kolbe's electrolytic reaction).

- HVZ reactions.
- Substitution of benzene ring (meta directive effect of carboxylic acid group) nitration and sulphonation.

*Tests for acids: formic acid, acetic acid and benzoic acid.*

*Uses of formic acid, acetic acid and benzoic acid.*

### 13. Organic compounds containing Nitrogen

**Aliphatic Amines:** General formula and, classification of amines. Structure of the amino group, nomenclature. Methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

- Amines

*Nomenclature, classification with examples, structure, general formula.*

*Methods of preparation:*

- From alcohol.
- From alkyl halide.
- From cyanide.
- From amide (Hofmann's degradation).
- From nitro compounds.
- Gabriel phthalimide Synthesis.

*Physical properties: comparison between primary, secondary and tertiary amines in terms of – state, solubility, boiling point (hydrogen bonding), comparison with alcohols.*

*Chemical properties:*

- Basic character of amines – comparison between primary, secondary and tertiary alkyl amines/ ammonia/ aniline. Effect of substituents on the basic strength of aniline
- Alkylation and acylation with mechanism.
- Reaction with nitrous acid.
- Carbylamine reaction.

*Distinction between primary, secondary and tertiary amines (Hinsberg's Test).*

## **Aniline**

*Preparation reduction of nitrobenzene.*

*Physical properties – state, solubility and boiling point.*

*Chemical properties:*

- *Reaction with HCl and H<sub>2</sub>SO<sub>4</sub>.*
- *Acetylation, alkylation.*
- *Benzoylation.*
- *Carbylamine reaction.*
- *Diazotisation.*
- *Electrophilic substitution (bromination, nitration and sulphonation).*

*Tests for aniline.*

*Uses of aniline.*

## **Cyanides and Isocyanides**

*Methods of preparation:*

*Cyanides:*

- *From alkyl halide.*
- *From amide.*

*Isocyanides:*

- *From alkyl halide.*

*From primary amines*

**Diazonium salts:** Preparation, chemical reactions and importance in synthetic organic chemistry.

*Preparation from aniline;*

*Properties: Sandmeyer's reaction, Gattermann reaction and Balz – Scheimann reaction, replacement of diazo group by – H, –OH, –NO<sub>2</sub>, coupling reaction with phenol and aniline.*

## **14. Biomolecules**

**Carbohydrates** – Definition, Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Carbohydrates: definition, classification - mono (aldose, ketose), oligo (di, tri, tetra saccharides) and polysaccharides with examples: reducing sugars and non-reducing sugars – examples and uses.

*Establishment of structures for glucose and fructose (open and cyclic) heating with HI, reaction with hydroxylamine, bromine water, acetic anhydride, nitric acid and phenyl hydrazine.*

*Test for glucose and fructose (bromine water test with equation).*

*Disaccharides – structures of sucrose, maltose and lactose (glycosidic linkage).*

*Polysaccharides – starch, cellulose, glycogen.*

**Proteins** – structural units of proteins. Basic idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins. Enzymes, hormones - elementary idea only.

*Proteins: Amino acids – general structure, classification and zwitter ion formation. Isoelectric point.*

*Classification of proteins on the basis of molecular shape; primary, secondary, tertiary and quaternary, structures of proteins, denaturation of proteins. (Definitions only. Details and diagrams are not required).*

**Vitamins** - Classification and functions.

*Vitamins A, B, C, D, E and K: classification (fat soluble and water soluble), deficiency diseases. (Chemical names and structures are not required).*

**Nucleic Acids** - DNA and RNA.

*Nucleic acids: basic unit – purine and pyrimidine, DNA – structure (double helical), RNA (No chemical structure required). Differences between DNA and RNA.*

## **15. Polymers**

Definition and classification on different parameters. Methods of polymerisation (addition and condensation), copolymerisation, and some important polymers: natural and synthetic like polythene, nylon polyesters, bakelite, rubber. Biodegradable and non-biodegradable polymers.

Classification based on source, on structure, on mode of polymerisation, on molecular forces, on growth (with free radical mechanism).

Preparation of important addition polymers - Polythene, polypropene, PVC, PTFE, polystyrene.

Rubber – natural and synthetic (Buna-N and Buna-S), vulcanisation of rubber.

Preparation of important condensation polymers - polyester, Nylon 66, Nylon 6, Bakelite, melamine (to be learnt in terms of monomers and equations).

Biodegradable polymers – PHBV, Nylon 2 - Nylon 6.

Uses.

## 16. Chemistry in Everyday life

**Chemicals in medicines** - analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

In medicine: antipyretics, analgesics, tranquillisers, antiseptics, disinfectants, anti-microbials, anti-fertility drugs, antihistamines, antibiotics, antacids.

Definition, common examples, uses.

Differences between antiseptics and disinfectants.

Structure not required.

**Chemicals in food** - preservatives, artificial sweetening agents, elementary idea of antioxidants.

Preservatives: role, example (Sodium benzoate).

Artificial sweetening agents: role, examples (aspartame, saccharine, sucralose and alitame).

**Soaps and detergents** - Classification and their cleansing action.

Soaps and detergents: classification, structure and some important examples.

Advantage of detergents over soaps; classification of detergents into anionic/biodegradable, cationic/non-biodegradable and non-ionic.

## PAPER II

### PRACTICAL WORK – 15 Marks

Candidates are required to complete the following experiments:

#### 1. Titrations

Oxidation-reduction titrations: potassium manganate (VII) / ammonium iron (II) sulphate; potassium manganate (VII) / oxalic acid.

The candidate may be required to determine the percentage purity of a compound and the number of molecules of water of crystallization in hydrated salts. In such experiments sufficient working details including recognition of the end point will be given.

Candidates will be required to calculate:

- Molarity
- Concentration in grams  $L^{-1}$  / molecular mass
- Number of molecules of water of crystallisation/ percentage purity.

**NOTE: Molarity must be calculated upto 4 decimal places at least, in order to avoid error.**

#### OBSERVATION TABLE

S. No.	(A)	(B)	(B – A)
	Initial burette reading (ml)	Final burette reading (ml)	Difference (ml)
1			
2			
3			

- Concordant reading is to be used for titre value. Concordant reading is two consecutive values which are exactly the same. Average will not be accepted as titre value.
- The table is to be completed in ink only. Pencil is not to be used.
- Overwriting will not be accepted in the tabular column.

#### Observations:

- Pipette size (should be same for all the candidates at the centre).
- Titre value (concordant value).

## 2. Study of the rate of reaction

The candidates will be required, having been given full instructions, to carry out an experiment on the rate of reaction, e.g. reaction between sodium thiosulphate and hydrochloric acid (using different concentrations for either), magnesium and dil. sulphuric acid/ dil. hydrochloric acid (using different concentrations).

- *Graph of volume vs. time and its interpretation.*
- *Relationship between concentration and rate, volume and rate and time and rate.*

## 3. Identification of the following compounds and functional groups based on observations

- Alcoholic group - glycerol
- Aldehyde group- formaldehyde
- Ketonic group – acetone
- Carboxylic group – benzoic acid
- Amino group - aniline

**\*Please Note: Carbylamine and acrolein tests should not be performed.**

*The student should learn to differentiate between colours, solution, ring and precipitate.*

## 4. Characteristic tests of carbohydrates and proteins

- Carbohydrates – glucose
- Proteins – powdered milk

*Identification should be of 'Carbohydrate' and 'Protein' not of individual substances.*

## 5. Experiments related to pH change using pH paper or universal indicator.

- Determination of pH of some solutions obtained from fruit juice, solutions of known and varied concentrations of acids, bases and salts.
- Comparison of pH of the solutions of strong and weak acids of the same concentration.

*Use of universal indicator/pH paper must be taught to the students.*

## 6. Electrochemistry

Setting up a simple voltaic cell.

Variation of cell potential in  $Zn/Zn^{2+}/Cu^{2+}/Cu$  with change in concentration of electrolyte ( $CuSO_4$ ,  $ZnSO_4$ ) at room temperature.

## 7. Qualitative analysis

Qualitative analysis: identification of single salt containing one anion and one cation:

Anions:  $CO_3^{2-}$ ,  $NO_2^-$ ,  $S^{2-}$ ,  $SO_3^{2-}$ ,  $SO_4^{2-}$ ,  $NO_3^-$ ,  $CH_3COO^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $C_2O_4^{2-}$ ,  $PO_4^{3-}$ .

Cations:  $NH_4^+$ ,  $Pb^{2+}$ ,  $Cu^{2+}$ ,  $Al^{3+}$ ,  $Fe^{3+}$ ,  $Zn^{2+}$ ,  $Mn^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$ ,  $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$ ,  $Mg^{2+}$ .

**NOTE:**

**Chromyl chloride test not to be performed.**

**For wet test of anions, sodium carbonate extract must be used (except for carbonate).**

**(Insoluble salts such as lead sulphate, barium sulphate, calcium sulphate, strontium sulphate will not be given).**

*Anions: Dilute acid group –  $CO_3^{2-}$ ,  $NO_2^-$ ,  $S^{2-}$ ,  $SO_3^{2-}$*

*Concentrated Acid Group –  $NO_3^-$ ,  $Cl^-$ ,  $Br^-$ ,  $I^-$ ,  $CH_3COO^-$ .*

*Special Group -  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $C_2O_4^{2-}$ .*

*Cations: Group Zero:  $NH_4^+$*

*Group I:  $Pb^{2+}$*

*Group II:  $Cu^{2+}$ ,  $Pb^{2+}$*

*Group III:  $Al^{3+}$ ,  $Fe^{3+}$*

*Group IV:  $Zn^{2+}$ ,  $Mn^{2+}$ ,  $Ni^{2+}$ ,  $Co^{2+}$*

*Group V:  $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$*

*Group VI:  $Mg^{2+}$*

**NOTE:**

- *Formal analytical procedure is required for Qualitative Analysis.*
- *Specific solvent for O.S. to be used;*
- *Before adding Group III reagents to the filtrate of Group II,  $H_2S$  must be removed followed by boiling with conc. Nitric acid.*
- *The right order for buffer ( $NH_4Cl$  and  $NH_4OH$ ) must be used.*
- *The flame test with the precipitate obtained in Group V for  $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Ca^{2+}$  will also be accepted as a confirmatory test.*

**For wet test of anions, sodium carbonate extract must be used (except for carbonate).**

**PATTERN OF CHEMISTRY  
PRACTICAL PAPER**

Questions in the practical paper will be set as follows:

<b>Question 1</b>	<b>Volumetric Analysis</b>
<b>Question 2</b>	<b>Any one or a combination of the following experiments:</b>
	• Study of the rate of reaction.
	• Identification of the organic compounds and functional groups based on observations.
	• Characteristic tests of carbohydrates and proteins.
	• Experiments related to pH determination using pH paper or universal indicator.
	• Electrochemistry.
<b>Question 3</b>	<b>Qualitative Analysis (single salt).</b>

**PROJECT WORK AND PRACTICAL FILE -  
15 Marks**

**Project Work – 10 Marks**

The project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

The candidate is to creatively execute **one** project/assignment on an aspect of Chemistry. Teachers may assign or students may select a topic of their choice. Following is only a suggestive list of projects.

**Suggested Evaluation criteria for Project Work:**

• Introduction / purpose
• Contents
• Analysis/ material aid (graph, data, structure, pie charts, histograms, diagrams, etc.)
• Presentation
• Bibliography

**NOTE:** According to the recommendation of International Union of Pure and Applied Chemistry (IUPAC), the groups are numbered from 1 to 18 replacing the older notation of groups IA ..... VIIA, VIII, IB ..... VIIB and 0. However, for the examination both notations will be accepted.

Old notation	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0		
New notation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

**Suggested Assignments:**

- Amino acids: Peptides, structure and classification, proteins structure and their role in the growth of living beings.
- Nucleic Acid: DNA and RNA – their structure. Unique nature. Importance in evolution and their characteristic features.
- Carbohydrates and their metabolism, Blood - haemoglobin and respiration.
- Vitamins and hormones
- Simple idea of chemical evolution.
- Natural polymers (any **five**) - structure, characteristics, uses. Synthetic polymers (any **five**) - method of preparation, structure, characteristics and uses.
- Types of Dyes - methods of preparation, characteristics and uses.
- Chemicals in medicines: antiseptics, antibiotics, antacids, etc. and their uses.
- Preparation of soap, nail polish, boot polish, varnish, nail polish remover, shampoo and perfumes.
- Chemicals and chemical processes in forensic studies.
- Insecticides, pesticides and chemical fertilisers.
- Ancient Indian medicines and medicinal plants.
- Organic Chemistry in Nutrition, Food Science and Biotechnology.
- Effect of Green House Gases.
- How Plastics have changed the world, both socially and economically.

**Practical File – 5 Marks**

The Visiting Examiner is required to assess students on the basis of the Chemistry Practical file maintained by them during the academic year.



# BIOLOGY (863)

## Aims:

1. To enable candidates to acquire the knowledge and to develop an understanding of biological terms, concepts, facts, principles, formulae, etc.
2. To develop the ability to apply the knowledge of biology in unfamiliar situations.
3. To develop experimental skills required in biology practical work.
4. To create awareness about the problems of the environment and the manner in which these problems can be overcome.
5. To develop the ability to appreciate biological phenomena in nature and the contribution of biology to human welfare.
6. To develop interest in plants and animals and in their respective environments.
7. To develop scientific attitude towards biological phenomena.
8. To create awareness of the fundamentals of human biology, food, health, nutrition and population control.

## CLASS XI

*Paper II: Practical: 3 hours ... 15 marks*

*There will be two papers in the subject:*

*Project Work ... 10 marks*

*Paper I: Theory: 3 hours ...70 marks*

*Practical File ... 5 marks*

### PAPER 1- THEORY: 70 Marks

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

S.NO.	UNIT	TOTAL WEIGHTAGE
1.	Diversity of Living Organisms	09 Marks
2.	Structural Organisation in Animals and Plants	11 Marks
3.	Cell: Structure and Function	15 Marks
4.	Plant Physiology	17 Marks
5.	Human Physiology	18 Marks
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I –THEORY – 70 Marks

**Note: All structures (internal and external) are required to be taught along with diagrams.**

### 1. Diversity of Living Organisms

#### (i) The Living World

What is living? Need for classification; three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature; tools for study of taxonomy—museums, zoological parks, herbaria, botanical gardens, key.

*Characteristics of living organisms. Need for classification should be discussed. Three domains of life – distinguishing features of (archaea, bacteria, eukarya). Definition and explanation of the terms taxonomy (numerical taxonomy, cytotaxonomy and chemotaxonomy) and systematics. Concept of species. Major taxonomical hierarchies (phylum, class, order, family, genus, species): definition and examples with reference to classification of man, house fly, mango and wheat. Rules of binomial nomenclature and advantages of using scientific names. Aids for study of taxonomy — a very brief idea of museum and herbaria, zoological parks and botanical gardens. Definition of taxonomical keys.*

*Three systems of classification – artificial, natural and phylogenetic.*

#### (ii) Biological Classification

Five kingdom classification; salient features and classification of Monera, Protista, Fungi, Plantae and Animalia. Lichens, Viruses and Viroids.

(a) *Five-kingdom system of classification and characteristics of different kingdoms with examples.*

(b) *Kingdom Monera: Bacteria - classification of bacteria according to shape, nutrition and mode of respiration; differences between gram +ve and gram –ve bacteria; types of reproduction – definition of fission, conjugation, transduction and transformation (details not required).*

*A brief idea of the role of different types of archaebacteria (methanogens, halophiles and thermoacidophiles in their extreme environments).*

*Mycoplasma – three distinctive features.*

*Economic importance with reference to role of bacteria in sewage treatment, antibiotics, energy production and household products (curd and cheese only).*

(c) *Kingdom Protista – only two general characteristics and two examples of subgroups: (i) Chrysophytes (ii) Dinoflagellates, (iii) Euglenoids, (iv) Slime moulds, (v) Protozoans (to be studied under rhizopods, flagellates, ciliates and sporozoans with two characteristics including modes of locomotion and two examples of each).*

(d) *Kingdom Fungi: general characteristics and mode of reproduction of each (including types of spores and sexual reproduction – definition of isogamy, anisogamy, oogamy, plasmogamy, karyogamy and dikaryophase). Zygomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes - characteristics with examples. Role of fungi in the field of medicine, bakery and environmental decomposition. Definition of lichens and mycorrhiza (ecto and endo).*

***Life cycles not required.***

(e) *Virus (characteristic features – link between living and non-living, structure of TMV and bacteriophage and contribution of the following scientists: D.J. Ivanowsky, M.W. Beijerinck, W.M. Stanley) and Viroid (definition only).*

#### (iii) Plant Kingdom

(a) *Algae - characteristics (morphology, common name, major pigments, stored food, composition of cell wall, flagellar number and position of insertion, habitat, mode of sexual reproduction) and examples of Chlorophyceae, Phaeophyceae, Rhodophyceae; Economic importance of algae – any five.*

- (b) *Bryophyta* – general characteristics, distinctive features of liverworts and mosses; graphic outline of life cycle of *Funaria* with reference to alternation of generations. Economic importance of bryophytes.
- (c) *Pteridophyta*: characteristics; classification into classes: *psilopsida* (*Psilotum*), *lycopsida* (*Selaginella*, *Lycopodium*), *sphenopsida* (*Equisetum*) and *pteropsida* (*Dryopteris*, *Pteris* and *Adiantum*). Graphic outline of life cycle of a typical pteridophyte (fern). Definition of homospory and heterospory with relevant examples. Economic importance.
- (d) *Gymnosperms*: general characteristics and graphic outline of life cycle of a typical gymnosperm (*Pinus*). Economic importance.
- (e) *Angiosperms* – general characteristics and classification into monocots and dicots; Graphic outline of life cycle of a typical angiosperm.
- (f) Comparison of life cycle patterns of different plant groups (*haplontic*, *diplontic* and *haplo-diplontic*).

(iv) Animal Kingdom

Animal Kingdom: animal construction - body plan (cell aggregate plan, blind-sac plan and tube-within-tube plan), symmetry (spherical, radial and bilateral symmetry), coelom development (diploblastic and triploblastic organisation in animals, acoelomate, pseudocoelomate, coelomate and haemocoelomate), segmentation.

*Non-chordata* - five distinguishing characters with two examples of *Porifera*, *Cnidaria*, *Ctenophora*, *Platyhelminthes*, *Nematoda* (*Aschelminthes*), *Annelida*, *Mollusca*, *Arthropoda*, *Echinodermata*, *Hemichordata*.

*Chordata* – sub-classification of *Chordata* with reference to notochord - sub phyla *Urochordata*, *Cephalochordata*. *Vertebrata* (classes – *cyclostomata*, *chondrichthyes*, *osteichthyes*, *amphibia*, *reptilia*, *aves* and *mammalia*) – three distinguishing characters with two examples of each).

2. Structural Organisation in Animals and Plants

(i) Morphology of Flowering Plants

- (a) Morphology and modifications of root, stem, leaf.

*Types of roots* (*tap*, *fibrous*, *adventitious*), *regions*, *modifications of roots for storage* (*Tuberous* – e.g. *Mirabilis* and *sweet potato*; *fusiform* – e.g. *radish*; *conical* – e.g., *carrot*; *napiform* – e.g. *turnip*), *respiration* (*pneumatophores*) and *support* (*stilt* and *prop*).

*Stems* – *features* (*nodes* *internodes*, *buds*), *modifications* – *underground* (*tuber*, *rhizome*, *corm*) *aerial* (*tendrils*, *thorn*, *Phylloclade*, *cladode*) and *sub-aerial* (*runner*, *sucker*, *stolon*, *offset*).

*Leaves* - *parts of a simple leaf*, *venation*, *types of leaves* (*simple* and *compound* – *pinnate* and *palmate*), *phyllotaxy* – *alternate*, *opposite*, *whorled* (with an example of each). *Modifications for mechanical support* (*tendrils*), *protection* (*spine*), *storage* (*bulb*), *reproduction* (*Bryophyllum*); *insectivorous plants* (*pitcher plant*, *Venus-fly-trap*).

- (b) Morphology of flower, fruit and seed. Structure of a typical flower, types of inflorescence (*racemose* and *cymose*).

*Structure of a typical flower*, *bracteates/ebracteate*, [symmetry (*actinomorphic*, *zygomorphic*), *trimerous/tetramerous/pentamerous* *complete/ incomplete*, *non-essential whorls* (*calyx*: *gamosepalous*, *polysepalous*, *corolla*: *gamopetalous*, *polysepalous*, *perianth*, *aestivation*: *valvate*, *twisted*, *imbricate*, *vexillary*), *essential whorls* (*androecium*: *cohesion* - *syngenesious*, *synandrous*, *monadelphous*, *diadelphous*, *polyadelphous*; *adhesion* – *epipetalous*, *epiphylous*; *number of lobes* – *monothealous*, *dithealous*; *Gynoecium*: *position of ovary* – *epigynous*, *hypogynous*, *perigynous*, *cohesion* – *apocarpous*, *syncarpous*, *number of locules* – *unilocular*, *bilocular*, *multilocular*], *types of inflorescence* (*racemose* and *cymose* – definition and differences; subtypes not required).

(ii) Anatomy of Flowering Plants

- (a) Plant Tissues: types of plant tissues: Meristematic tissues: classification of meristematic tissue. Permanent Tissues: structure and function of simple tissues (parenchyma, collenchyma and sclerenchyma) and complex tissues (xylem and phloem), tissue system. Internal structure of root, stem, and leaf.

*Characteristics of meristematic tissue; classification of meristems based on origin and location; structure, function and location of permanent tissues; simple and complex tissues; epidermal, ground and vascular tissue systems.*

*Cellular diagrams of T.S. of roots and stem and V.S. of monocot and dicot leaves are required.*

- (b) Secondary growth in dicot stem and dicot root

*Basic idea of how secondary growth takes place in dicot stems and roots (with the help of outline diagrams) and formation of annual rings. Activity of the cambium and cork cambium, formation of secondary tissues, differences between heart wood and sap wood, early wood and late wood. Definition of bark.*

(iii) Structural Organisation in Animals

- (a) Animal tissues

*Epithelial, connective, muscular and nervous tissues to be taught with the help of diagrams.*

*Location, structure and functions of epithelial tissues (simple, stratified, pseudostratified, specialised – transitional, neurosensory and pigmented) with examples, types of junctions (tight, adhering and gap junctions) location and general structure of areolar tissue - functions of different types of cells (fibroblasts, macrophages, Mast cells, plasma cells, adipocytes); fibrous connective tissue (ligaments and tendon); difference between bone and cartilage; types of cartilage (hyaline, white fibrous, yellow elastic and calcified); T.S. of hyaline*

*cartilage, T.S and L.S. of mammalian bone(to be taught with the help of diagrams); different types of muscles and their functions; structure of a neuron (types – unipolar, bipolar, multipolar, myelinated, non-myelinated). Neuroglial cells.*

- (b) Cockroach

*Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach) - a brief account only.*

**3. Cell: Structure and Function**

- (i) Cell - the Unit of Life

Cell theory and cell as the basic unit of life: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall (including definition of plasmodesmata); cell organelles – ultrastructure and function; endomembrane system (endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles), mitochondria, ribosomes, plastids, microbodies; cytoskeleton, cilia, flagella, centrioles; nucleus, nuclear membrane, chromatin, nucleolus.

*Historical aspects, cell theory, size and shape of cells; general structure of prokaryotic cell.*

*General structure of eukaryotic cell, ultra-structure and function of cell wall, cell membrane (description of fluid mosaic model; functions of the plasma membrane: active and passive transport, brief explanation of facilitated diffusion (uniport, symport and antiport) with one example. Mitochondria, nucleus (structure and types of chromosomes on the basis of the position of centromere, satellite), types of plastids, endomembrane system (endoplasmic reticulum, Golgi complex, lysosomes and vacuoles), ribosomes, microbodies, cytoskeleton, cilia, flagella and centrioles; difference between prokaryotic cell and eukaryotic cell, plant and animal cell, microfilaments and microtubules, flagella and cilia.*

(ii) Biomolecules

Proteins, carbohydrates, lipids, nucleic acids, enzymes.

*Carbohydrates: general classification and functions of: monosaccharides (glucose, ribose and deoxyribose), disaccharides (maltose, lactose and sucrose), polysaccharides (glycogen, starch, cellulose, inulin, and chitin).*

*Proteins: amino acids – (structure: glycine, alanine, serine); amino acids as zwitter-ion; examples of acidic, basic, neutral, sulphur containing amino acids; essential and nonessential amino acids; levels of protein structure (primary, secondary, tertiary and quaternary); functions of proteins.*

*Lipids: classification, structure and functions of fats and oils.*

*Enzymes: general properties, nomenclature and classification of enzymes according to type of reactions, co-factors (prosthetic groups, coenzymes and metal ions. Factors affecting enzyme activity - temperature, pH, substrate concentration. Competitive inhibitors.*

(iii) Cell Cycle and Cell Division

Cell cycle, mitosis, meiosis and their significance.

*Definition of C-value, different stages of cell cycle ( $G_0$ ,  $G_1$ , S and  $G_2$  and M).*

*Different stages of mitosis and prophase – I of meiosis with diagrams. Significance of mitosis and meiosis. Differences between mitosis and meiosis.*

#### 4. Plant Physiology

(i) Transport in Plants

Movement of water, gases and nutrients; cell to cell transport, diffusion, facilitated diffusion, active transport; plant-water relations, imbibition, water potential, osmosis, plasmolysis; long distance transport of water - absorption, apoplast, symplast, transpiration pull, root pressure and guttation; transpiration, opening and closing of stomata; uptake and translocation of mineral nutrients - transport of food - phloem transport, mass flow hypothesis; diffusion of gases.

*Definition of imbibition; factors affecting imbibition; importance of imbibition, characteristics and significance of diffusion; osmosis - endosmosis and exosmosis; significance of osmosis and turgidity - osmotic pressure, turgor pressure, wall pressure; definition of turgidity, plasmolysis, deplasmolysis, importance of water; active and passive absorption of water; apoplastic and symplastic movements, definition of water potential and its components viz. solute, matrix and pressure potential (**numerical problems based on this concept are not required**). Root pressure – definition and experiment to demonstrate it. Explanation and definition of transpiration, significance of transpiration. Stomatal mechanism – starch ↔ sugar interconversion and  $K^+$ -ion mechanism. Mechanism of ascent of sap by cohesion – tension and transpiration pull theory. Guttation – definition, differences between transpiration and guttation. Function of stomata, lenticel and hydathode. Mineral uptake by active and passive transport.*

*Transport of solutes; evidences which indicate that downward movement of organic solutes takes place in phloem (girdling and tracer techniques), mechanism of translocation - mass flow hypothesis.*

(ii) Mineral Nutrition

Essential minerals, macro- and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

*Criteria for essentiality of minerals, hydroponics, macro and micronutrients; role and deficiency symptoms (hunger signs) of various elements. Mineral toxicity.*

*Root nodule formation, biological nitrogen fixation, non-symbiotic nitrogen fixation and symbiotic nitrogen fixation. Role of Rhizobium, Azospirillum, Azolla, Anabaena and Nostoc; importance of nitrogenase complex and leghaemoglobin pigment. Nitrogen cycle (graphic outline).*

(iii) Photosynthesis in higher plants

Photosynthesis as a mean of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis (elementary

idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C<sub>3</sub> and C<sub>4</sub> pathways; factors affecting photosynthesis.

*Contributions of Priestley, Sachs, Engelmann, van Neil; differences between absorption and action spectra.*

*Brief idea of photosynthetic pigments (difference between chlorophyll 'a' & 'b', carotenoids and xanthophyll), photochemical phase - pigment systems, cyclic and non-cyclic photophosphorylation, chemiosmotic hypothesis; biosynthetic phase - C<sub>3</sub> and C<sub>4</sub> cycles – graphic representation in correct sequence (carboxylation, glycolytic reversal and regeneration of pentose); Differences between C<sub>3</sub> and C<sub>4</sub> plants, C<sub>3</sub> and C<sub>4</sub> cycles, Photosystems I and II, Photorespiration pathway in brief - explanation of how RuBP carboxylase acts as RuBP oxygenase. Kranz anatomy. Blackman's Law of limiting factors, factors affecting photosynthesis.*

#### (iv) Respiration in Plants

Exchange of gases; cellular respiration - glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations - number of ATP molecules generated; amphibolic pathways; respiratory quotient.

*Types of respiration; mechanism of respiration: glycolysis, Krebs' cycle, ETS (only flowchart). Oxidative phosphorylation – definition; Brief idea of fermentation and Amphibolic pathway. Definition of respiratory quotient and RQ values of carbohydrates, proteins and fats.*

#### (v) Plant Growth and Development

Seed germination; phases of plant growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators - auxin, gibberellin, cytokinin, ethylene, ABA; seed dormancy; vernalisation; photoperiodism.

*A brief idea about differentiation, dedifferentiation and redifferentiation. Phases of growth in meristems, growth rate –*

*definition; measurement of growth by direct method and use of auxanometer, factors affecting growth.*

*Discovery and physiological role of growth regulators in plants (such as auxins, gibberellins, cytokinins, ethylene and abscisic acid – four effects of each); application of growth regulators, Definition of dormancy and quiescence; causes and methods of breaking seed dormancy.*

*Photomorphogenesis in plants.*

*A brief idea of short day, long day and day neutral plants; critical day length, definition and differences between photoperiodism and vernalisation.*

## 5. Human Physiology

### (i) Digestion and Absorption.

Alimentary canal and digestive glands, role of digestive enzymes; peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egestion; nutritional and digestive disorders.

*Calorific value of carbohydrates, proteins and fats per gram; Structure and functions of the digestive organs and their associated glands, types of dentition (thecodont, heterodont, diphyodont) and dental formula of human; diagram of the digestive system with correct position of the organs and the associated glands; diagrammatic representation of T.S. of gut showing the four layers - histology of individual organs not required; physiology of digestion and absorption of food; definition of bolus, peristalsis, deglutition, emulsification; assimilation of digested food; disorders of the digestive system – Protein Energy Malnutrition (PEM), indigestion, constipation, vomiting, jaundice, diarrhoea.*

### (ii) Breathing and exchange of gases.

Respiratory organs in animals (recall only); Respiratory system in humans; mechanism of breathing and its regulation - exchange of gases, transport of gases and regulation of respiration, respiratory volumes; disorders related to respiration.

*Organs involved in respiration; mechanism of pulmonary gas exchange; breathing process should be explained showing the action of diaphragm and intercostal muscles, regulation of respiration; transport of oxygen in the blood, oxyhaemoglobin dissociation curve; transport of CO<sub>2</sub>; chloride shift, pulmonary air volumes and lung capacities; disorders of respiratory system such as - asthma, emphysema, occupational respiratory disorders.*

(iii) Body fluids and circulation.

Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system - structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system.

*Composition of blood plasma, functions of plasma proteins, blood corpuscles. Difference between closed and open vascular system; external and internal structure of heart; working of the heart and blood flow through the heart during different phases should be described under the following headings - auricular systole, auricular diastole, ventricular systole, ventricular diastole and joint diastole; definition of stroke volume and cardiac output, regulation of heart beat, ECG; arterial blood pressure (systolic and diastolic), double circulation. The internal structure of artery, vein and capillary. Importance of ABO groups in blood transfusion, Rh factor and its importance in transfusion and pregnancy; clotting of blood to be taught briefly; lymphatic system – a brief idea of lymph (composition and function), lymphatic capillaries and lymph nodes; disorders of the circulatory system such as hypertension, coronary artery disease, angina pectoris and heart failure.*

(iv) Excretory products and their elimination.

Modes of excretion - ammonotelism, ureotelism, uricotelism; human excretory system - structure and function; urine

formation, osmoregulation; regulation of kidney function, renin - angiotensin, atrial natriuretic factor, ADH and diabetes insipidus; role of erythropoietin; role of other organs in excretion; disorders of the excretory system - uraemia, renal failure, renal calculi, nephritis; dialysis and artificial kidney.

*Define, differentiate and explain the terms ammonotelism, ureotelism and uricotelism; external and internal structure of the kidney (L.S.); structure of nephron; physiology of urine formation - ultra filtration, selective reabsorption and active (tubular) secretion. Counter current system, regulation of urine formation, definition of micturition, renin-angiotensin system, role of atrial natriuretic factor, ADH and erythropoietin.*

*Role of skin, liver and lungs in excretion. Homeostasis – definition. Disorders of the excretory system - uraemia, renal failure, renal calculi, nephritis.*

*Haemodialysis and artificial kidney.*

(v) Locomotion and Movement

Types of movement - ciliary, flagellar, muscular; skeletal muscles - contractile proteins and muscle contraction; skeletal system and its functions; joints; disorders of muscular and skeletal system.

*Locomotion: Basic aspects of human skeleton (number and names of the bones of axial and appendicular skeleton).*

*Functions of human skeleton; different types of joints - their location and function; general properties of muscles; structure of skeletal muscle - sliding filament theory of muscle contraction; chemical events during muscle contraction; definition of summation, tetanus, rigor mortis, differences between red and white muscles.*

*Disorders of muscular and skeletal system:*

- (i) Myasthenia gravis, (ii) Tetany, (iii) Muscular dystrophy, (iv) Arthritis, (v) Osteoporosis, (vi) gout.

(vi) Neural Control and Coordination

Neuron and nerves; nervous system in humans - central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse; reflex action; sensory perception; sense organs; elementary structure and functions of eye and ear.

*Structure and functions of various parts of the brain and spinal cord; conduction of nerve impulses through nerve fibre (non-myelinated and myelinated) and through synapse; physiology of reflex action, natural reflex and conditioned reflex - definition, examples and differences; reflex arc to be taught with diagram showing the pathway by means of arrows; eye and ear: structure and working to be done along with the help of - diagrams. Elementary idea of nose (olfactory receptor) and tongue (gustato receptor).*

(vii) Chemical Co-ordination and Integration

Endocrine glands and hormones; human endocrine system - hypothalamus, pituitary, pineal, thyroid, parathyroid, adrenal, pancreas, gonads; mechanism of hormone action (elementary idea); role of hormones as messengers and regulators, hypo - and hyperactivity and related disorders; dwarfism, acromegaly, cretinism, goitre, exophthalmic goitre, diabetes mellitus and diabetes insipidus, Grave's disease, Addison's disease.

*Brief idea of location of endocrine glands; role of hypothalamus; hormones secreted by different lobes of pituitary and their functions; feedback control of tropic hormones to be discussed giving examples; hormones of pineal, thymus, thyroid, parathyroid, pancreas, adrenal glands, GI tract (gastrin, secretin, GIP, CCK-PZ) and gonads; mechanism of hormone action (through cAMP and steroid hormones only); effects of hypo secretion and hyper secretion of various hormones of the above mentioned glands-*

*Note: Diseases related to all the human physiological systems to be taught in brief.*

**PAPER II**

**PRACTICAL WORK – 15 Marks**

**1. Scientific Techniques**

To study parts of a dissecting microscope and compound microscope.

*The students should know all parts of dissecting and compound microscope and be able to handle the microscope independently.*

**2. Physiology**

- (i) Food tests: test for starch, glucose, sucrose, proteins and fats.

*Food tests: tests should be reported in tabular form. Both positive and negative tests should be reported.*

- (ii) To study the effect of thawing, heat and alcohol on permeability of beet root cells.

*To study the effect of heat on permeability of cell membrane of beet root cells: students should record the observations at very low temperature, room temperature and higher temperature to see the degree of leaching and conclude accordingly. Experiment on effect of alcohol on the permeability with regard to leaching.*

- (iii) Separation of plant pigments from leaves by chromatography.

- (iv) Effect of different carbon dioxide concentrations on the rate of photosynthesis.

- (v) Demonstration of plasmolysis (using *Rhoeo* leaf / onion bulb).

- (vi) Demonstration of osmosis in living plant cells (potato osmoscope).

**3. Morphology**

- (i) Morphology and modification of roots, stems and leaves.

*Teachers can show examples of roots, stems and leaves modified for mechanical support, storage, reproduction or perennation – students should learn to identify and draw the specimens.*

*Leaves: phyllotaxy – alternate, opposite whorled (with an example of each), shape, venation, simple and compound.*



- (ii) Preparation of temporary slides of *Mucor* / *Rhizopus*.

*The teacher should guide the students on the technique of culture, staining and mounting the material and then observing under the microscope. The students should also be able to make labelled diagrams and record observations.*

#### 4. Cytology

Preparation of temporary slides of -

- (i) Onion peel (to study the plant cell)
- (ii) Stages of mitosis in onion root tips.

*Correct method of selecting the root tip, fixing, staining and mounting should be taught. Different stages should be observed first in low power and after locating the area, the students should see it under high power. Various stages should be drawn and labelled.*

- (iii) T.S of monocot and dicot stem.
- (iv) T.S. of monocot and dicot root.

*After staining and mounting the tissue students should be able to draw the diagram and label all the parts as seen under the low power of microscope.*

#### 5. Spotting: (Three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing at least two characteristics).

- (a) Identification of stained preparations of the following:
  - (i) Stages of meiosis.
  - (ii) Identification of mammalian blood cells.
  - (iii) Bacteria
  - (iv) *Spirogyra*
  - (v) *Amoeba*
  - (vi) Yeast
- (b) Identification of the following specimens -
  - (i) Liverworts
  - (ii) Moss
  - (iii) Fern
  - (iv) *Pinus*
  - (v) Mushroom
  - (vi) One monocot plant – bamboo
  - (vii) One dicot plant – *Petunia*

- (viii) Sponge
- (ix) *Hydra*
- (x) Tape worm
- (xi) Leech
- (xii) Silk Worm
- (xiii) Rohu fish

*Students should be taught how to identify, draw, label and give at least two significantly visible characteristics, as observed, of each spot, in a given time of three minutes.*

- (c) Comment on experimental set up studied in physiology.
  - (a) Osmosis
  - (b) Transpiration
  - (c) Photosynthesis
  - (d) Transpiration pull.

*Students should identify (aim of the experiment), draw a labelled diagram of the physiological set-up and write observation and inference of the experiment within the allotted time i.e., 3 minutes.*

### PROJECT WORK AND PRACTICAL FILE – 15 Marks

#### Project Work – 10 Marks

Candidate is to creatively execute one project/assignment on any aspect of Biology. Preference is to be given to investigatory projects. Following is only a suggestive list of projects. Teachers may assign or students may choose any one project of their choice.

- (i) Project related to experiment on any aspect of plant life/animal life.
- (ii) Project related to any aspect of environment.
- (iii) Diabetes.
- (iv) Endocrine disorders.
- (v) Yeast fermentation and production of alcohol or any other commercial industry dependant on plants and/or animals or their products.

In addition, students may be taught how to culture:

- Earthworms.
- Protozoans.
- Moulds.
- Setting up of an aquarium.

## Suggested Evaluation Criteria for Project Work:

### Format of the Project:

– Content
– Introduction
– Presentation (graphs, tables, charts, newspaper cuttings, diagrams, photographs, statistical analysis if relevant)
– Conclusion/ Summary
– Bibliography

### Practical File – 5 Marks

**Each practical done during the year, needs to be recorded by the student in the Practical file and the same must be checked, signed and dated by the teacher.**

Teachers are required to assess students on the basis of the Biology Practical file maintained by them during the academic year.

### SCIENTISTS AND THEIR CONTRIBUTIONS

1. Beijerinck – *Contagium vivum fluidum*
2. Carl Woese – Three domains of life
3. Curtis – Transpiration is a necessary evil
4. Engelmann – Action spectrum of photosynthesis
5. Ernst Mayr – Biological species concept
6. F.F. Blackman – Law of limiting factor
7. F W Went – Isolated Auxins
8. Farmer and Moore – Discovered meiosis
9. G.N. Ramachandran – Analysis of Protein structure
10. Garner and Allard – Photoperiodism
11. George Palade – Discovered ribosomes
12. Huxley and Niedergerke – Sliding filament theory
13. Ivanowsky – Discovered Tobacco Mosaic Virus
14. Karl Landsteiner – Blood groups
15. Katherine Esau – Anatomy of plants
16. Levitt – Active K<sup>+</sup> transport theory of stomatal movement
17. Munch – Proposed mass flow hypothesis
18. Peter Mitchell – Chemiosmotic coupling hypothesis
19. Priestley – Plants restore oxygen in the air
20. Renner – Coined the terms active and passive absorption of water
21. Robert Brown – Discovered nucleus

22. Singer and Nicolson – Proposed fluid mosaic model of plasma membrane
23. Sutherland – cyclic AMP as second messenger
24. T. O. Diener – Discovered viroids
25. Thomas Addison – Father of endocrinology
26. Van Neil – Oxygen released during photosynthesis comes from water
27. W. M. Stanley – Crystallised TMV
28. Waldeyer – Coined the term chromosome
29. Whittaker – Five kingdoms of life
30. William Harvey – Discovered circulatory system

### LIST OF ABBREVIATIONS TO BE STUDIED

1. 2,4-D – 2, 4-Dichlorophenoxy acetic acid
2. ABA – Abscisic Acid
3. ANF – Atrial Natriuretic Factor
4. CCK –Cholecystokinin
5. DPD – Diffusion Pressure Deficit
6. ECG – Electrocardiogram
7. ERV – Expiratory Reserve Volume
8. ETS – Electron Transport System
9. FAD – Flavin Adenine Dinucleotide
10. FRC – Functional Residual Capacity
11. GA – Gibberellic acid
12. GFR – Glomerular Filtration Rate
13. GIP – Gastric Inhibitory Peptide
14. IBA – Indole Butyric Acid
15. IRV – Inspiratory Reserve Volume
16. LHC – Light Harvesting Complex
17. NAA – Naphthalene Acetic Acid
18. NADPH – Nicotinamide Adenine Dinucleotide Phosphate (reduced)
19. OAA – Oxaloacetic Acid
20. PEM – Protein Energy Malnutrition
21. PGA – Phosphoglyceric Acid
22. PGRs – Plant Growth Regulators
23. PPLO – Pleuro Pneumonia Like Organism
24. PZ – Pancreozymin
25. RQ – Respiratory Quotient
26. RUBISCO – Ribulose Bisphosphate Carboxylase oxygenase
27. RuBP – Ribulose Bisphosphate
28. TMV – Tobacco Mosaic Virus

## CLASS XII

There will be two papers in the subject:

**Paper I:** Theory: 3 hours ... 70 marks

**Paper II:** Practical: 3 hours ... 15 marks

Project Work ... 10 marks

Practical File ... 5 marks

### **PAPER I- THEORY: 70 Marks**

There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.

S. No.	UNIT	TOTAL WEIGHTAGE
1.	Reproduction	16 Marks
2.	Genetics and Evolution	15 Marks
3.	Biology and Human Welfare	14 Marks
4.	Biotechnology and its Applications	10 Marks
5.	Ecology and Environment	15 Marks
<b>TOTAL</b>		<b>70 Marks</b>

## PAPER I –THEORY – 70 Marks

**All structures (internal and external) are required to be taught along with diagrams.**

### 1. Reproduction

#### (i) Reproduction in Organisms

Reproduction, a characteristic feature of all organisms for continuation of species; modes of reproduction - asexual and sexual reproduction; asexual reproduction - binary fission, sporulation, budding, gemmule formation, fragmentation; vegetative propagation in plants.

*Definition of life span; life span of a few organisms (banana, rice, rose, banyan, butterfly, fruit fly, tortoise, crocodile, parrot, crow, elephant, dog, horse, and cow).*

*Asexual reproduction – definition, types (binary fission in Amoeba and Paramecium, budding in yeast and Hydra, conidia in Penicillium, zoospores in Chlamydomonas, gemmules in sponges), definition of clone.*

*Vegetative propagation – definition, vegetative propagules (tuber of potato, rhizome of ginger, bulbil of Agave, leaf buds of Bryophyllum, offset of water hyacinth, runner of grass, sucker of pineapple, bulb of onion).*

*Sexual reproduction: Plants – definition, phases of life cycle (juvenile/vegetative, reproductive and senescence), unusual flowering phenomenon (bamboo and Strobilanthes kunthiana). Animals – continuous and seasonal breeders (definition, differences and examples).*

*Events in sexual reproduction – pre-fertilisation (gametogenesis and gamete transfer in plants and animals), chromosome number in the cells of house fly, fruit fly, butterfly, human beings, rat, dog, maize, apple, onion, cat, rice, Ophioglossum; fertilization (definition, types - external and internal), post-fertilisation (embryogenesis), definition and example of parthenogenesis, differences between asexual and sexual reproduction.*

#### (ii) Sexual reproduction in flowering plants

Flower structure; development of male and female gametophytes; pollination - types, agencies and examples; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events - development of endosperm and embryo, development of seed and formation of fruit; special modes - apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.

*Pre-fertilisation structures and events.*

*Structure of microsporangium, T.S. of anther microsporogenesis, structure and development of pollen grain, viability of pollen grain, economic importance of pollen grain. Pistil – structure of megasporangium (L.S. of anatropous ovule), megasporogenesis, structure and development of female gametophyte.*

*Types of pollination (autogamy, chasmogamy, cleistogamy, geitonogamy, xenogamy), adaptations in flowers pollinated by wind, water and insects. Advantages of self and cross-pollination. Contrivances for prevention of self-pollination. Pollen-pistil interaction in terms of incompatibility/compatibility, events leading to fertilisation, definition of triple fusion and double fertilization, changes in the ovary and ovule for seed and fruit formation. Significance of double fertilization. Apomixis, polyembryony, parthenocarpy to be explained briefly. Fruits to be classified into true and false, structure (L.S) of a typical fruit (mango and coconut); Internal structure of dicot (bean) and monocot (maize) seeds; definition, differences and examples of albuminous and non-albuminous seeds. Significance of seed and fruit formation. Significance of dispersal of seeds.*

*Post-fertilisation events - embryo formation (monocot and dicot); types of endosperm (cellular, nuclear and helobial); definition of perisperm.*

### (iii) Human Reproduction

Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis - spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation (elementary idea); parturition (elementary idea); lactation (elementary idea).

*Organs of male and female reproductive system and their functions; internal structure of testis and ovary to be taught with the help of diagrams; gametogenesis-spermatogenesis (including spermiogenesis and spermiation) oogenesis; hormonal control of gametogenesis, structure of sperm and mature ovum, menstrual cycle - different phases and hormone action, differences between oestrous and menstrual cycle, menarche and menopause, physico-chemical events during fertilisation, implantation, embryonic development up to blastocyst formation, important features of human embryonic development (formation of heart, limbs, digits, appearance of hair on head, eyelashes, separation of eye lids, external genital organs and first movement of foetus with reference to time period) placenta and its functions. Parturition; lactation – hormonal control and importance.*

### (iv) Reproductive Health

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control - need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies - IVF, ZIFT, GIFT (elementary idea for general awareness).

*Definition of reproductive health, programs of reproductive health (family planning, RCH), population explosion - role of government in controlling the population, contraceptives methods and their methods of action (natural-periodic abstinence, withdrawal or coitus interruptus, lactational amenorrhea; artificial – barriers, IUDs, oral pills, implants and surgical methods,*

*definition of medical termination of pregnancy (MTP) and reasons for it; causes of infertility. Amniocentesis and its role in detecting genetic defects. Assisted reproductive technologies: IVF, IUT, ZIFT, ICSI, GIFT, AI, IUI. - definition and application only. Causes, symptoms and methods of prevention of sexually transmitted diseases (gonorrhoea, syphilis, genital herpes, chlamydia, genital warts, trichomoniasis, hepatitis- B, AIDS).*

## 2. Genetics and Evolution

### (i) Principles of inheritance and variation

Heredity and variation: Mendelian inheritance; deviations from Mendelism - incomplete dominance, co-dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosomal theory of inheritance; chromosomes and genes; sex determination - in humans, fruit fly, birds and honey bee; linkage and crossing over; mutation; sex linked inheritance - haemophilia, colour blindness; Mendelian disorders in humans; chromosomal disorders in humans.

*Explanation of the terms heredity and variation; Mendel's Principles of inheritance; reasons for Mendel's success; definition of homologous chromosomes, autosomes and sex chromosomes; alleles – dominant and recessive; phenotype; genotype; homozygous; heterozygous, monohybrid and dihybrid crosses; back cross and test cross, definitions to be taught with simple examples using Punnett square. Incomplete dominance with examples from plants (snapdragon - *Antirrhinum*) and co-dominance in human blood group, multiple alleles – e.g. blood groups, polygenic inheritance with one example of inheritance of skin colour in humans (students should be taught examples from human genetics through pedigree charts. They should be able to interpret the patterns of inheritance by analysis of pedigree chart). Biological importance of Mendelism. Pleiotropy with reference to the example of Phenylketonuria (PKU) in human beings and*

*starch synthesis in pea seeds. Chromosomal theory of inheritance; autosomes and sex chromosomes (sex determination in humans, fruit fly, birds, honey bees and grasshopper), sex-linked inheritance - with reference to Drosophila (colour of body-yellow and brown; and colour of eyes-red and white), and man (haemophilia and colour blindness), definition and significance of linkage and crossing over. Mutation: spontaneous, induced, gene (point - transition, transversion and frame-shift); chromosomal aberration: euploidy and aneuploidy; human genetic disorders: phenylketonuria, thalassaemia, colour blindness, sickle cell anaemia; chromosomal disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome.*

(ii) Molecular basis of Inheritance

Search for genetic material and DNA as genetic material; structure of DNA and RNA; DNA packaging; DNA replication; central dogma; transcription, genetic code, translation; gene expression and regulation - lac operon; human and rice genome projects; DNA fingerprinting.

*Structure of eukaryotic chromosomes with reference to nucleosome; properties of genes such as ability to replicate, chemical stability, mutability and inheritability. Search for DNA as genetic material - Griffith's experiment, Hershey and Chase's experiment, Avery, McLeod and McCarty's experiment; double helical model of DNA (contributions of Meischer, Watson and Crick, Wilkins, Franklin and Chargaff); Differences between DNA and RNA; types of RNA (tRNA, mRNA and rRNA, snRNA, hnRNA); central dogma - concept only; reverse transcription (basic idea only), Meselson and Stahl's experiment, replication of DNA (role of enzymes, namely DNA polymerase and ligase), transcription, post-transcriptional processing in eukaryotes (splicing, capping and tailing). Intron, exon, cistron, (definitions only). Discovery and essential features of genetic code. Definition of codon. Protein synthesis - translation in prokaryotes. Gene expression in prokaryotes; lac operon in E. coli.*

*Human Genome Project: goal; methodologies [Expressed Sequence Tags (EST), Sequence Annotation], salient features and applications. DNA finger printing - technique, application and ethical issues to be discussed briefly. Rice Genome Project (salient features and applications).*

(iii) Evolution

Origin of life; biological evolution and evidences for biological evolution (palaeontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution - variation (mutation and recombination) and natural selection with examples, types of natural selection; gene flow and genetic drift; Hardy - Weinberg's principle; adaptive radiation; human evolution.

*Origin of life - abiogenesis and biogenesis, effect of oxygen on evolution to show that reducing atmosphere is essential for abiotic synthesis. Important views on the origin of life, modern concept of origin of life, Oparin Haldane theory, definition of protobionts, coacervates), vestigial organs; Miller and Urey experiment. Evidences of evolution: morphological evidences, definition and differences between homologous and analogous organs (two examples each from plants and animals). Embryological evidences - theory of recapitulation, definition and differences between ontogeny and phylogeny. Palaeontological evidence - definition of fossils. Geological time scale (with reference to dominant flora and fauna) Biogeographical evidence - definition of biogeography, molecular (genetic) evidences -for example genome similarity, universal genetic code; Darwin's finches (adaptive radiation).*

*Lamarckism: brief idea of Lamarck's theory, evidences in favour of Lamarckism such as evolution of long neck of giraffe to be discussed. Darwinism: salient features of Darwinism, contribution of Malthus, criticism of Darwinism. Examples of natural selection - Long neck of giraffe, industrial*

*melanism, resistance of mosquitoes to DDT and resistance of bacteria to antibiotics, Lederberg's replica plating experiment, Neo-Darwinism (Modern Synthetic Theory); Variation - causes of variation, Hugo de Vries theory of mutation - role of mutation in evolution; Hardy Weinberg's principle, factors affecting Hardy Weinberg equilibrium: gene migration or gene flow, genetic drift (Founder's effect, bottle-neck effect), mutation, genetic recombination and natural selection, types of natural selection (directional, disruptive and stabilizing). Evolution of man - three features of each of the ancestors Dryopithecus, Ramapithecus, Australopithecus, Homo habilis, Homo erectus, Homo neanderthalensis, Cro-magnon man and Homo sapiens leading to man of today.*

### 3. Biology and Human Welfare

#### (i) Human Health and Diseases

*Pathogens; parasites causing human diseases (common cold, dengue, chikungunya, typhoid, pneumonia, amoebiasis, malaria, filariasis, ascariasis, ring worm) and their control; Basic concepts of immunology - vaccines; cancer, HIV and AIDS; Adolescence - drug and alcohol abuse.*

*Communicable and non-communicable diseases; modes of transmission, causative agents, symptoms and prevention; viral diseases (common cold, chikungunya and dengue), bacterial diseases (typhoid, pneumonia, diphtheria and plague), protozoal diseases (amoebiasis, and malaria, graphic outline of life cycle of Plasmodium), helminthic diseases (ascariasis, and filariasis); fungal (ringworm); cancer - types of tumour (benign, malignant), causes, diagnosis and treatment, characteristics of cancer cells (loss of contact inhibition and metastasis).*

*Immunity (definition and types – innate and acquired, active and passive, humoral and cell-mediated), Interferons – definition, source and function; structure of a typical antibody molecule, types of antibodies - IgG, IgA, IgM, IgD and IgE (function and*

*occurrence, e.g. in serum, saliva, colostrum); vaccination and immunisation, allergies and allergens – definition and general symptoms of allergies; autoimmunity, primary and secondary lymphoid organs and tissues, brief idea of AIDS – causative agent (HIV), modes of transmission, diagnosis (ELISA), symptoms, replication of retrovirus in the infected human cell (including diagram) and prevention.*

*Alcoholism and smoking - effects on health.*

*Drugs: effects and sources of opioids, cannabinoids, cocaine and barbiturates.*

*Reasons for addiction; prevention and control of alcohol and drug abuse.*

#### (ii) Strategies for enhancement in food production

*Improvement in food production: green revolution, plant breeding, tissue culture, single cell protein, biofortification, apiculture and animal husbandry.*

*Measures for proper maintenance of dairy farms and poultry farms; apiculture and pisciculture – definition, brief idea and advantages of each.*

*Animal breeding - brief idea of inbreeding, out-breeding, cross-breeding and artificial insemination, Multiple Ovulation Embryo Transfer Technology (MOET). Advantages of artificial insemination.*

*Plant breeding – a brief reference to green revolution. Steps in plant breeding (germplasm collection, evaluation, selection, cross hybridisation or artificial hybridisation (concept of emasculation and bagging), selection and testing of superior recombinants, testing, release and commercialisation of new cultivars), advantages of mutation breeding, examples of some Indian hybrid crops like wheat, rice, maize, sugarcane, millet. Definition of heterosis and inbreeding depression.*

*Application of plant breeding for (i) disease resistance [examples of some disease-resistant varieties of crops for example wheat (Himgiri), Brassica (Pusa swarnim), cauliflower (Pusa shubhra, Pusa snowball K*

– 1), Cow pea (*Pusa komal*), chilli (*Pusa sadabahar*), (ii) insect resistance [examples of some insect resistant varieties of crops – Brassica (*Pusa Gaurav*), flat bean (*Pusa sem 2*, *Pusa sem 3*), okra (*Pusa sawani*, *Pusa A-4*)], (iii) improved food quality (biofortification, e.g., wheat – Atlas 66, maize hybrids, iron fortified rice). Tissue culture (technique and application – micropropagation, somaclones, disease free plants and somatic hybridisation), single cell protein – source and significance.

### (iii) Microbes in Human Welfare

In household food processing, industrial production, sewage treatment, energy generation and microbes as biocontrol agents and biofertilisers. Antibiotics.

*Use of microbes in:* (i) Household products: *Lactobacillus* (curd), *Saccharomyces* (bread), *Propionibacterium* (Swiss cheese); (ii) Industrial products: beverages (with and without distillation), antibiotics (Penicillin – discovery and use); sources (microbes) and uses of organic acids, alcohols and enzymes (lipase, pectinase, protease, streptokinase) in industry, source (microbes) and applications of Cyclosporin-A, Statins. (iii) Sewage treatment – primary and secondary treatment; (iv) Production of biogas (methanogens, biogas plant, composition of biogas and process of production); (v) Microbes as biocontrol agents (ladybird, dragonfly, *Bacillus thuringiensis*, *Trichoderma*, Nucleopolyhedrovirus (Baculovirus), and (vi) Microbes as biofertilisers (*Rhizobium*, *Azospirillum*, *Azotobacter*, Mycorrhiza, Cyanobacteria), IPM, harmful effects of chemical pesticides.

## 4. Biotechnology and its Applications

### (i) Biotechnology - Principles and processes

Genetic Engineering (recombinant DNA technology).

*Definition and principles of biotechnology; isolation of genomic (chromosomal) DNA (from bacteria/plant cell/animal cell, by cell lysis), isolation of gene of interest (by*

*electrophoresis), steps of formation of recombinant DNA, discovery, nomenclature, features and role of restriction enzymes (EcoRI, HindIII) and role of ligase; cloning vectors (features of a good cloning vector, examples of cloning vectors like pBR322, Agrobacterium, retroviruses, bacterial artificial chromosome (BAC), yeast artificial chromosome (YAC)), methods of transfer of rDNA into a competent host, e.g. by direct-method (temperature shock), microinjection, gene gun, methods of selection of recombinants (antibiotic resistance, insertional inactivation/blue-white selection), cloning of recombinants, i.e., gene amplification (by in vivo or in vitro method - using PCR technique), bioreactor (basic features and uses of stirred tank and sparged tank bioreactors), downstream processing.*

### (ii) Biotechnology and its applications

Applications of biotechnology in health and agriculture: human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms - Bt crops; transgenic animals; biosafety issues, biopiracy and biopatents.

*In agriculture: for production of crops tolerant to abiotic stresses (cold, drought, salt, heat); pest-resistant crops (Bt-crops, RNAi with reference to Meloidogyne incognita); crops with enhanced nutritional value (golden rice).*

*In medicine: insulin, gene therapy - with reference to treatment of SCID, molecular diagnosis by PCR, ELISA and use of DNA/RNA probe.*

*Transgenic animals for bioactive products like alpha-1-antitrypsin for emphysema, alpha-lactalbumin; vaccine safety testing, chemical safety testing; study of diseases.*

*Role of GEAC, definition and two examples of biopiracy, biopatent; ethical issues.*

## 5. Ecology and Environment

### (i) Organisms and Populations

Organisms and environment: habitat and niche, population and ecological adaptations; population interactions -



mutualism, competition, predation, parasitism; population attributes - growth, birth rate and death rate, age distribution.

*Definition of ecology; major biomes of India – Tropical rain forests, deciduous forests, deserts and sea coasts (their annual temperatures and precipitation). Definition of habitat and niche.*

*Definition of population; population attributes: sex ratio, types of age distribution pyramids for human population; definition of population density, natality, mortality, emigration, immigration, carrying capacity. Ways to measure population density. Calculation of natality and mortality.*

*Population growth: factors affecting population growth and population growth equation; growth models: exponential growth and logistic growth along with equations, graph and examples of the same; life history variations: definition of reproductive fitness and examples.*

*Population interactions – definition of mutualism, competition (interspecific, interference, competitive release and Gause's Principle of Competitive Exclusion), predation (adaptations in organisms to avoid predation), parasitism (ecto-, endo-, and brood parasites), commensalism, amensalism.*

## (ii) Ecosystem

*Ecosystems: patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles (carbon and phosphorous); ecological succession; ecological services - carbon fixation, pollination, seed dispersal, oxygen release (in brief).*

*Definition and types of ecosystems; structure of ecosystem (brief idea about biotic and abiotic components).*

*Effects of abiotic factors (temperature, water, light, soil) on living organisms, definition of stenothermal, eurythermal, stenohaline and euryhaline), responses to abiotic factors (regulate, conform, migrate, suspend); ecological adaptations:*

*morphological, physiological and behavioural in response to loss of water and extremes of temperature in plants and animals including humans. Allen's rule.*

*Structure and function of pond ecosystem; ecosystem functions: (i) Productivity – gross primary productivity (GPP), net primary productivity (NPP) and secondary productivity (ii) Decomposition (fragmentation, leaching, catabolism, humification and mineralization), factors affecting rate of decomposition (iii) Energy flow. Various types of food chains – grazing and detritus, food webs, trophic levels, ecological pyramids – energy, number and biomass (iv) Nutrient cycle – definition of biogeochemical cycles – gaseous cycle (Carbon) and sedimentary cycle (Phosphorous).*

*Definition of PAR, 10% Law, standing crop and standing state.*

*Succession: definition to explain the meaning, kinds of succession (hydrarch, xerarch; primary and secondary succession with examples), definition of pioneer community, climax community and sere; significance of ecological succession.*

*Ecological services and their cost.*

## (iii) Biodiversity and its Conservation

*Concept of biodiversity; patterns of biodiversity; importance of biodiversity; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, national parks, sanctuaries and Ramsar sites*

*Definition of biodiversity, few examples of each type of biodiversity - species, ecosystem and genetic. Global biodiversity and proportionate number of species of major taxa of plants, invertebrates and vertebrates; patterns of biodiversity (latitudinal gradients, species-area relationship – graph and equation), “rivet popper hypothesis”, importance of species diversity to the ecosystem (narrowly utilitarian, broadly utilitarian, ethical terms).*

*Examples of some recently extinct organisms, causes of loss of biodiversity (habitat loss*

and fragmentation, over-exploitation, alien species invasion, co-extinction).

*Biodiversity conservation: In-situ methods - protected areas: biosphere reserves, national parks, wildlife sanctuaries, sacred groves; ex-situ methods - captive breeding, zoo, botanical gardens, cryopreservation, wild life safari, seed banks, tissue culture. Definitions and examples of each of the above. Hotspots, Ramsar sites and Red Data Book.*

*The place, year and main agenda of historic conventions on biological diversity (the Earth Summit and the World Summit).*

#### (iv) Environmental Issues

Air pollution and its control; water pollution and its control; agrochemicals and their effects; solid waste management; radioactive waste management; greenhouse effect and climate change; ozone layer depletion; deforestation; any one case study as success story addressing environmental issue(s).

*Definition of pollution and pollutant; environmental issues: air pollution and its control, major sources of gaseous and particulate pollutants, control devices for air pollution such as: scrubbers and electrostatic precipitators, catalytic converter, CNG, Bharat stages, noise pollution: harmful effects and control; Water pollution, major sources and its control, composition of waste water, thermal pollution, eutrophication - cultural or accelerated, BOD, effect of sewage discharge on BOD and dissolved oxygen content in river; case studies of waste water treatment (FOAM and EcoSan); Soil pollution – sources, effects and control, agrochemicals and their harmful effects, integrated organic farming, contribution of Ramesh Chandra Dagar, biomagnification and bioconcentration; solid waste management, Radioactive waste management, e-waste.*

*A brief understanding of the concept of deforestation (slash and burn agriculture or jhum cultivation's contribution), greenhouse effect. Impact of global warming in terms of*

*climatic changes, rise in sea levels, melting of ice caps, El Nino effect; impact on animals and plants due to climate changes. Ozone depletion – causes, ozone hole, Dobson unit, effects on plants and animals, methods to control ozone depletion, Montreal protocol. The following case studies as success stories addressing environmental issues: Chipko Movement, Joint Forest Management, contribution of Ahmed Khan of Bangalore.*

*Main provisions of Environmental Acts — Environmental Protection Act, Water (prevention and control of pollution), Air (prevention and control of pollution act).*

## PAPER II

### PRACTICAL WORK – 15 Marks

- 1) **Taxonomy:** Study floral characteristics through dissection of flowers, drawing floral formula and diagrams of following families:
  - (i) Malvaceae: type – China rose / Hollyhock.
  - (ii) Leguminosae: subfamily – Papilionaceae – type – Sweet pea/ Pea/ Bean/ Sesbania/ Clitoria (single flower).
  - (iii) Solanaceae: type – Petunia / Datura / Brinjal Flower / Solanum nigrum.
  - (iv) Liliaceae: type – Onion or Amaryllidaceae – type – Lily/Spider lily/ Tiger lily/ Tube rose/ Gladiolus.

*Floral characteristics should be explained by dissection of flowers. Students should be taught how to cut vertical section of the flower and draw accurately labelled diagrams. The technique of drawing floral diagrams with the **mother axis in the right position is necessary.** Floral formula should be correctly written. Identification of the correct family giving reasons, technique of cutting T.S. and L.S of ovary should be explained and accordingly correct labelled-diagram should be drawn.*

*Students should know the examples of plants (belonging to each family) which are of economic importance. The examples of common names of plants must be supported with correct scientific names as well.*

**NOTE: In the examination, candidates will be tested on any one of the above families.**

## 2) Simple biochemical and physiological experiments

(i) Study of arrangement/distribution of stomata in dicot and monocot leaves.

(ii) Study of soils from **two different sites**.

*Collect soil samples from two different areas and make a comparative study of their texture, moisture content, humus content, water holding capacity and pH.*

### **Guidelines for collection of soil samples:**

- *Texture - loamy, sandy and clayey soil.*
- *Moisture content – Soil samples are to be collected from a dry place and a wet place. Alternatively, samples of soil can be dried to different degrees in oven/by keeping in sun.*
- *Humus Content – Collect one sample from roadside/barren land and one sample from garden/cultivated field.*
- *Water holding capacity – Pour given amount of water in known weight of soil sample and record the volume of water retained by the soil sample.*
- *pH – Add water to the soil sample and test with pH paper.*

*Students should be taught to set up and demonstrate the experiments with correct diagram of the setup, record their observations methodically and give conclusions. This will give a clear idea of the physiological processes. Questions can be asked based on the above physiological processes studied.*

(iii) To study the effect of enzyme action at three different temperatures and pH on starch solution.

*Effect of enzyme (amylase/ diastase) action at three different temperatures (low- below 10°C, optimum - 37°C and high – above 70°C) and pH (acidic, neutral and basic) on starch solution.*

(iv) To isolate DNA from available plant material.

*Isolation of DNA from spinach leaves, green pea seeds, pulp of banana and papaya.*

*Take half a ripe and peeled banana into a beaker and add 50 ml of extraction fluid (1.5gm table salt +10 ml liquid detergent +90 ml distilled water). Place the beaker in a water bath set at 60 °C for 15 minutes. Stir gently with a glass rod. Filter 5ml of cooled content into a clean test tube and add 5ml of cold 90% ethanol. DNA molecules separate out and appear as white fibres.*

## 3) Slide preparation

- (i) Germination of pollen grain in a nutrient medium.
- (ii) T.S. of ovary of any locally available flower, to show marginal / axile placentation.
- (iii) T.S. of a hydrophyte stem.
- (iv) T.S. of a xerophytic leaf (*Nerium*).
- (v) L.S. of monocot and dicot seed (soaked seeds of maize/wheat, pea/ bean.)

*The technique of staining and mounting neatly should be explained. Students should also know how to make labelled outline diagrams. They should also be taught to identify the mount under low/ high power of microscope. **Two** identifying features of the above need to be mentioned.*

4) **Spotting: (three minutes to be given for each spot which includes identification, drawing a labelled diagram and writing at least two identifying characteristics).**

**NOTE: Spotting must be done on a separate answer sheet during examination, which should be handed over to the Examiner immediately after spotting.**

- (i) Identify and comment on the following:
  - (a) T.S. of ovary of mammal (Permanent slide).
  - (b) T.S. of testis of mammal (Permanent slide).
  - (c) Germinating pollen grain (slide/chart).
  - (d) T.S. of ovary to show the type of placentation (marginal, axile, basal (LS), parietal).
  - (e) T.S. of blastula / blastocyst of a mammal (chart/ slide).
  - (f) Whole mount of *Plasmodium* sporozoite (slide /chart).

- (g) Whole mount of *Entamoeba histolytica* trophozoite (slide/chart).
- (h) Preserved specimen/ chart/ model of *Ascaris*.
- (ii) Comment upon ecological adaptations of plants and animals.

*Models/ virtual images/ charts of one plant and one animal found in xeric and aquatic habitats. Examples: Hydrilla, cactus, fish and camel.*

- (iii) Flowers adapted to pollination by different agencies – insect and wind.

*Students should be able to identify the type of pollination of the given flower, draw the diagram of the flower and give two reasons for the type of pollination. Example: Hibiscus and grass.*

*Students should be taught how to identify, draw, label and give significantly visible characteristics as observed, of each spot, in a given time of three minutes. 'T.S.', 'model', 'whole mount', 'chart', 'image' of the specimen should be mentioned as a part of identification.*

- (viii) Drug addiction and community.
- (ix) Role of micro-organisms in industry.
- (x) Human population.
- (xi) Mendelian Inheritance
- (xii) Environmental resistance.
- (xiii) Traditional and modern methods: Study of a few traditional methods of pest deterrence vis-a-vis modern methods of pest control - viability of traditional methods in today's scenario and limitations and dangers of modern methods.
- (xiv) Role of agrochemicals in increasing food production.

### Suggested Evaluation Criteria for Project Work:

#### Format of the Project:

– Content
– Introduction
– Presentation (graphs, tables, charts, newspaper cuttings, diagrams, photographs, statistical analysis if relevant)
– Conclusion/ Summary
– Bibliography

## PROJECT WORK AND PRACTICAL FILE – 15 Marks

### Project Work – 10 Marks

The project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

The candidate is to creatively execute **one** project/assignment on an aspect of biology. Preference is to be given to investigatory projects. Teachers may assign or students may choose any **one** project of their choice. Students can choose any other project besides the ones indicated in the list. Following is **only a suggestive** list of topics:

- (i) Genetic disorders
- (ii) Gene therapy
- (iii) Human Genome Project
- (iv) DNA fingerprinting
- (v) Bio-piracy
- (vi) Cancer.
- (vii) AIDS/Hepatitis.

### Practical File – 5 Marks

The Visiting Examiner is required to assess students on the basis of the Biology Practical file maintained by them during the academic year.

Each practical done during the year, needs to be recorded by the student in the Practical file and the same must be checked, signed and dated by the teacher.

### SCIENTISTS AND THEIR CONTRIBUTIONS:

1. Oparin: Coacervates, Conditions on primitive earth were favourable for chemical evolution
2. Stanley Miller & Harold Urey: Recreated probable conditions on primitive earth
3. Ernst Haeckel: Proposed the recapitulation theory
4. Charles Darwin: Natural Selection
5. Lamarck: Inheritance of acquired characters
6. Hugo de Vries: Mutation
7. T. R. Malthus: Theory of Human Population Growth/ Essays on population

8. Alec Jeffrey: DNA finger printing
9. Temin and Baltimore: Reverse transcription.
10. Jacob, Monad and Lwoff: proposed Lac operon.
11. Watson and Crick: Structure of DNA
12. Nirenberg and Khorana: Genetic code
13. Benzer: Cistron, recon, muton
14. Gregor Mendel: Father of genetics
15. Sutton and Boveri: Chromosomal theory of inheritance
16. Hugo de Vries, Correns and Tschermack: Rediscovered Mendelism
17. T H Morgan: Linkage
18. P Maheshwari: Plant tissue culture
19. Henking: Discovered X-chromosome
20. F. Meischer: Isolated nucleic acid from pus cells, called Nuclein
21. Chargaff: Rule of equivalence in DNA structure
22. F. Griffith: Transformation in bacteria
23. Avery, MacLeod and McCarty: DNA is the genetic material
24. Hershey and Chase: DNA is the genetic material
25. Meselson and Stahl: Semi-conservative replication of DNA
26. G. Gamow: Triplet nature of codons
27. S Ochoa: discovered polynucleotide phosphorylase
28. Wallace: divided the Earth into biogeographical regions
29. M S Swaminathan: Green revolution in India
30. H Boyer: discovered Restriction Enzyme
31. S Cohen: method to transfer plasmid DNA in host cells
32. R. Mishra: Father of Indian Ecology
33. E. Wilson: coined the term Biodiversity
34. P Ehrlich: Rivet Popper Hypothesis
35. Sanger: DNA/Protein sequencing
5. DDT – Dichloro diphenyl trichloro ethane
6. DFC- Detritus Food Chain
7. EFB- European Federation of Biotechnology
8. EST- Expressed Sequence Tags
9. ET- Embryo Transfer
10. GFC- Grazing Food Chain
11. GMO- Genetically Modified Organism
12. GPP- Gross Primary Productivity
13. hnRNA - Heterogeneous Nuclear Ribo Nucleic Acid
14. IARI- Indian Agricultural Research Institute
15. IMR- Infant Mortality Rate
16. IRRI- International Rice Research Institute
17. ICSI - Intra Cytoplasmic Sperm Injection
18. IUCD/IUD – Intra uterine contraceptive device
19. IUCN- International Union for Conservation of Nature and Natural Resources
20. IUI- Intra Uterine Insemination
21. IUT- Intra Uterine Transfer
22. JFM- Joint Forest Management
23. LAB- Lactic Acid Bacteria
24. MALT- Mucosal Associated Lymphoid Tissue
25. MMR- Maternal Mortality Rate
26. MOET- Multiple Ovulation Embryo Transfer Technology
27. NACO- National AIDS Control Organisation
28. NPP- Net Primary Productivity
29. PID- Pelvic Inflammatory Diseases
30. PKU- Phenyl ketonuria
31. RCH- Reproductive and Child Health Care Programmes
32. SCID – Severe Combined Immuno Deficiency
33. SNPs - Single Nucleotide Polymorphisms
34. snRNA- Small Nuclear Ribo Nucleic Acid
35. sRNA - Soluble Ribo Nucleic Acid
36. SSBP – Single Strand Binding Protein
37. UTR - Untranslated Region
38. VNTRs - Variable Number of Tandem Repeats

#### **LIST OF ABBREVIATIONS TO BE STUDIED**

1. ADA- Adenosine Deaminase
2. CMI- Cell Mediated Immunity
3. CNG- Compressed Natural Gas
4. CPCB- Central Pollution Control Board

# COMPUTER SCIENCE (868)

## Aims (Conceptual)

- (1) To understand algorithmic problem solving using data abstractions, functional and procedural abstractions, and object based and object-oriented abstractions.
- (2) To understand: (a) how computers represent, store and process data at different levels of abstraction that mediate between the machine and the algorithmic problem solving level and (b) how they communicate with the outside world.

- (3) To create awareness of ethical issues related to computing and to promote safe, ethical behavior.
- (4) To make students aware of future trends in computing.

## Aims (Skills)

To devise algorithmic solutions to problems and to be able to code, validate, document, execute and debug the solution using the Java programming system.

## CLASS XI

There will be two papers in the subject:

**Paper I:** Theory..... 3 hours...70 marks

**Paper II:** Practical..... 3 hours...30 marks

### PAPER I –THEORY – 70 MARKS

Paper I shall be of 3 hours duration and be divided into two parts.

**Part I (20 marks):** This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to the entire syllabus.

**Part II (50 marks):** This part will be divided into three Sections, A, B and C. Candidates will be required to answer **two** questions out of **three** from Section A (each carrying 10 marks) and **two** questions out of **three** from Section B (each carrying 10 marks) and **two** questions out of **three** from Section C (each carrying 5 marks). Therefore, a total of **six** questions are to be answered in Part II.

### SECTION A

#### Basic Computer Hardware and Software

##### 1. Numbers

Representation of numbers in different bases and interconversion between them (e.g. binary, octal, decimal, hexadecimal). Addition and subtraction operations for numbers in different bases.

*Introduce the positional system of representing numbers and the concept of a base. Discuss the conversion of representations between different bases using English or pseudo code. These algorithms are also good examples for defining different functions in a class modelling numbers*

*(when programming is discussed). For addition and subtraction (1's complement and 2's complement) use the analogy with decimal numbers, emphasize how carry works (this will be useful later when binary adders are discussed).*

##### 2. Encodings

- (a) Binary encodings for integers and real numbers using a finite number of bits (sign-magnitude, 2's complement, mantissa-exponent notation).

*Signed, unsigned numbers, least and most significant bits. Sign-magnitude representation and its shortcomings (two representations for 0, addition requires extra step); two's-complement representation. Operations (arithmetic, logical, shift), discuss the basic algorithms used for the arithmetic operations. Floating point representation: normalized scientific notation, mantissa-exponent representation, binary point (discuss trade-off between size of mantissa and exponent). Single and double precision.*

- (b) Characters and their encodings (e.g. ASCII, ISCII, Unicode).

*Discuss the limitations of the ASCII code in representing characters of other languages. Discuss the Unicode representation for the local language. Java uses Unicode, so strings in the local language can be used (they can be displayed if fonts are available) – a simple table lookup for local language equivalents for Latin (i.e. English) character strings may be done. More details on Unicode are available at [www.unicode.org](http://www.unicode.org).*

### 3. Propositional logic, Hardware implementation, Arithmetic operations

- (a) Propositional logic, well-formed formulae, truth values and interpretation of well formed formulae, truth tables.

*Propositional variables; the common logical connectives ((not)(negation),  $\wedge$  (and)(conjunction),  $\vee$  (or)(disjunction),  $\Rightarrow$  (implication),  $\Leftrightarrow$  (equivalence)); definition of a well-formed formula (wff); representation of simple word problems as wff (this can be used for motivation); the values **true** and **false**; interpretation of a wff; truth tables; satisfiable, unsatisfiable and valid formulae.*

- (b) Logic and hardware, basic gates (AND, NOT, OR) and their universality, other gates (NAND, NOR, XOR, XNOR), half adder, full adder.

*Show how the logic in (a) above can be realized in hardware in the form of gates. These gates can then be combined to implement the basic operations for arithmetic. Tie up with the arithmetic operations on integers discussed earlier in 2 (a).*

### SECTION B

The programming element in the syllabus is aimed at algorithmic problem solving and **not** merely rote learning of Java syntax. The Java version used should be 5.0 or later. For programming, the students can use any text editor and the javac and java programs or any other development environment: for example, BlueJ, Eclipse, NetBeans etc. BlueJ is strongly recommended for its simplicity, ease of use and because it is very well suited for an 'objects first' approach.

### 4. Introduction to Object Oriented Programming using Java

*Note that topics 5 to 12 should be introduced almost simultaneously along with Classes and their definitions.*

### 5. Objects

- (a) Objects as data (attributes) + behaviour (methods or methods); object as an instance of a class.

*Difference between object and class should be made very clear. BlueJ ([www.bluej.org](http://www.bluej.org)) and Greenfoot ([www.greenfoot.org](http://www.greenfoot.org)) can be used for this purpose.*

- (b) Analysis of some real-world programming examples in terms of objects and classes.

*Use simple examples like a calculator, date, number etc. to illustrate how they can be treated as objects that behave in certain well-defined ways and how the interface provides a way to access behaviour. Illustrate behaviour changes by adding new methods, deleting old methods or modifying existing methods.*

- (c) Basic concept of a virtual machine; Java Virtual Machine (JVM); compilation and execution of Java programs (the javac and java programs).

*The JVM is a machine but built as a program and not through hardware. Therefore it is called a virtual machine. To run, JVM machine language programs require an interpreter. The advantage is that such JVM machine language programs (.class files) are portable and can run on any machine that has the java program.*

- (d) Compile time and run time errors; basic concept of an exception, the Exception class, try-catch, throw, throws and finally.

*Differentiate between compile time and run time errors. Run time errors crash the program. Recovery is possible by the use of exceptions. Explain how an exception object is created and passed up until a matching catch is found. This behaviour is different from the one where a value is returned by a deeply nested method call.*

### 6. Primitive values, Wrapper classes, Types and casting

Primitive values and types: byte, int, short, long, float, double, boolean, char. Corresponding wrapper classes for each primitive type. Class as type of the object. Class as mechanism for user defined types. Changing types through user defined casting and automatic type coercion for some primitive types.

*Ideally, everything should be a class; primitive types are defined for efficiency reasons; each primitive type has a corresponding wrapper class. Classes as user defined types. In some cases types are changed by automatic coercion or casting – e.g. mixed type expressions. However, casting in general is not a good idea and should be avoided, if possible.*

## 7. Variables, Expressions

Variables as names for values; named constants (final), expressions (arithmetic and logical) and their evaluation (operators, associativity, precedence). Assignment operation; difference between left-hand side and right-hand side of assignment.

*Variables denote values; variables are already defined as attributes in classes; variables have types that constrain the values it can denote. Difference between variables denoting primitive values and object values – variables denoting objects are references to those objects. The assignment operator = is special. The variable on the LHS of = denotes the memory location while the same variable on the RHS denotes the contents of the location e.g.  $i=i+2$ .*

**NOTE: Library functions for solving expressions may be used as and when required.**

## 8. Statements, Scope

Statements; conditional (if, if else, if else if, switch case) ternary operator, looping (for, while, do while), continue, break; grouping statements in blocks, scope and visibility of variables.

*Describe the semantics of the conditional and looping statements in detail. Evaluation of the condition in conditional statements.*

*Nesting of blocks. Variables with block scope, method scope, class scope. Visibility rules when variables with the same name are defined in different scopes.*

## 9. Methods and Constructors

Methods and Constructors (as abstractions for complex user defined operations on objects), methods as mechanisms for side effects; formal arguments and actual arguments in methods; different behaviour of primitive and object arguments. Static methods and variables. The **this** operator. Examples of algorithmic problem solving using methods (number problems, finding roots of algebraic equations etc.).

*Methods are like complex operations where the object is implicitly the first argument. Operator **this** denotes the current object. Methods typically return values. Illustrate the difference between primitive values and object values as arguments (changes made inside methods persist after the call for object values). Static definitions as class variables and class methods visible and shared by all instances. Need for static methods and variables. Introduce the main method – needed to begin execution. Constructor as a special kind of method; the new operator; multiple constructors with different argument structures; constructor returns a reference to the object.*

## 10. Arrays, Strings

Structured data types – arrays (single and multi-dimensional), strings. Example algorithms that use structured data types (searching, finding maximum/minimum, sorting techniques, solving systems of linear equations, substring, concatenation, length, access to char in string, etc.).

*Storing many data elements of the same type requires structured data types – like arrays. Access in arrays is constant time and does not depend on the number of elements. Sorting techniques (bubble, selection, insertion), Structured data types can be defined by classes – String. Introduce the Java library String class and the basic operations on strings (accessing individual characters, various substring operations, concatenation, replacement, index of operations).*

## SECTION C

## 11. Basic input/output Data File Handling (Binary and Text)

- (a) Basic input/output using Scanner and Printer classes.

*Input/output exceptions. Tokens in an input stream, concept of whitespace, extracting tokens from an input stream (String Tokenizer class). The Scanner class can be used for input of various types of data (e.g. int, float, char etc.) from the standard input stream. Similarly, the Printer class handles output. Only basic input and output using these classes should be covered.*



*Discuss the concept of a token (a delimited continuous stream of characters that is meaningful in the application program – e.g. words in a sentence where the delimiter is the blank character). This naturally leads to the idea of delimiters and in particular whitespace and user defined characters as delimiters. As an example show how the StringTokenizer class allows one to extract a sequence of tokens from a string with user defined delimiters.*

(b) Data File Handling.

*Need for Data file, Input Stream, Output Stream, Byte Stream (FileInputStream and FileOutputStream), Character Stream (FileReader, FileWriter), Operations- Creation, Reading, Writing, Appending, and Searching.*

## 12. Recursion

Concept of recursion, simple recursive methods (e.g. factorial, GCD, binary search, conversion of representations of numbers between different bases).

*Many problems can be solved very elegantly by observing that the solution can be composed of solutions to ‘smaller’ versions of the same problem with the base version having a known simple solution. Recursion can be initially motivated by using recursive equations to define certain methods. These definitions are fairly obvious and are easy to understand. The definitions can be directly converted to a program. Emphasize that any recursion must have a base case. Otherwise, the computation can go into an infinite loop.*

## 13. Implementation of algorithms to solve problems

The students are required to do lab assignments in the computer lab concurrently with the lectures. Programming assignments should be done such that each major topic is covered in at least one assignment. Assignment problems should be designed so that they are sufficiently challenging and make the student do algorithm design, address correctness issues, implement and execute the algorithm in Java and debug where necessary.

*Self-explanatory.*

## 14. Packages

Definition, creation of packages, importing user defined packages, interaction of objects across packages.

*Java Application Programming Interface (API), development of applications using user defined packages.*

## 15. Trends in computing and ethical issues

- (a) Artificial Intelligence, Internet of Things, Virtual Reality and Augmented Reality.

*Brief understanding of the above and their impact on Society.*

- (b) Cyber Security, privacy, netiquette, spam, phishing.

*Brief understanding of the above.*

- (c) Intellectual property, Software copyright and patents and Free Software Foundation.

*Intellectual property and corresponding laws and rights, software as intellectual property.*

*Software copyright and patents and the difference between the two; trademarks; software licensing and piracy. free Software Foundation and its position on software, Open Source Software, various types of licensing (e.g. GPL, BSD).*

*Social impact and ethical issues should be discussed and debated in class. The important thing is for students to realise that these are complex issues and there are multiple points of view on many of them and there is no single ‘correct’ or ‘right’ view.*

## PAPER II: PRACTICAL – 30 MARKS

This paper of three hours duration will be evaluated internally by the school.

The paper shall consist of three programming problems from which a candidate has to attempt any one. The practical consists of the two parts:

- (1) Planning Session

- (2) Examination Session

The total time to be spent on the Planning session and the Examination session is three hours. A maximum of 90 minutes is permitted for the Planning session and 90 minutes for the Examination

session. **Candidates are to be permitted to proceed to the Examination Session only after the 90 minutes of the Planning Session are over.**

### Planning Session

The candidates will be required to prepare an algorithm and a hand-written Java program to solve the problem.

### Examination Session

The program handed in at the end of the Planning session shall be returned to the candidates. The candidates will be required to key-in and execute the Java program on seen and unseen inputs individually on the Computer and show execution to the examiner. A printout of the program listing, including output results should be attached to the answer script containing the algorithm and handwritten program. This should be returned to the examiner. The program should be sufficiently documented so that the algorithm, representation and development process is clear from reading the program. Large differences between the planned program and the printout will result in loss of marks.

Teachers should maintain a record of all the assignments done as part of the practical work throughout the year and give it due credit at the time of cumulative evaluation at the end of the year. Students are expected to do a **minimum** of twenty assignments for the year and **ONE** project based on the syllabus.

### LIST OF SUGGESTED PROJECTS:

#### PRESENTATION / MODEL BASED/ APPLICATION BASED

1. Creating an expert system for road-traffic management (routing and re-routing of vehicles depending on congestion).
2. Creating an expert system for medical diagnosis on the basis of symptoms and prescribe a suitable treatment.
3. Creating a security system for age-appropriate access to social media.

4. Simulate Adders using Arduino Controllers and Components.
5. Simulate a converter of Binary to Decimal number systems using Arduino Controllers and Components.
6. Develop a console-based application using Java for Movie Ticket Reservation.
7. Develop a console-based application using Java to encrypt and decrypt a message (using cipher text, Unicode-exchange, etc).
8. Develop a console-based application using Java to find name of the bank and branch location from IFSC.
9. Develop a console-based application using Java to calculate taxable income (only direct tax).
10. Develop a console-based application using Java to develop a simple text editor (text typing, copy, cut, paste, delete).

### EVALUATION

Marks (out of a total of 30) should be distributed as given below:

#### Continuous Evaluation

Candidates will be required to submit a work file containing the practical work related to programming assignments done during the year and **ONE** project.

Programming assignments done throughout the year	10 marks
Project Work (based on any topic from the syllabus)	5 marks

#### Terminal Evaluation

Solution to programming problem on the computer	15 Marks
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(Marks should be given for choice of algorithm and implementation strategy, documentation, correct output on known inputs mentioned in the question paper, correct output for unknown inputs available only to the examiner).

## CLASS XII

There will be two papers in the subject:

**Paper I: Theory**..... 3 hours....70 marks

**Paper II: Practical**..... 3 hours....30 marks

### PAPER I –THEORY – 70 MARKS

Paper I shall be of 3 hours duration and be divided into two parts.

**Part I (20 marks):** This part will consist of compulsory short answer questions, testing knowledge, application and skills relating to the entire syllabus.

**Part II (50 marks):** This part will be divided into three Sections, A, B and C. Candidates will be required to answer **two** questions out of **three** from Section A (each carrying 10 marks) and **two** questions out of **three** from Section B (each carrying 10 marks) and **two** questions out of **three** from Section C (each carrying 5 marks). Therefore, a total of **six** questions are to be answered in Part II.

### SECTION A

#### 1. Boolean Algebra

- (a) Propositional logic, well formed formulae, truth values and interpretation of well formed formulae (wff), truth tables, satisfiable, unsatisfiable and valid formulae. Equivalence laws and their use in simplifying wffs.

*Propositional variables; the common logical connectives ( $\sim$  (not)(negation),  $\wedge$  (and)(conjunction),  $\vee$  (or)(disjunction),  $\Rightarrow$  (implication),  $\Leftrightarrow$  (biconditional); definition of a well-formed formula (wff); representation of simple word problems as wff (this can be used for motivation); the values **true** and **false**; interpretation of a wff; truth tables; satisfiable, unsatisfiable and valid formulae.*

*Equivalence laws: commutativity of  $\wedge$ ,  $\vee$ ; associativity of  $\wedge$ ,  $\vee$ ; distributivity; De Morgan's laws; law of implication ( $p \Rightarrow q \equiv \sim p \vee q$ ); law of biconditional ( $(p \Leftrightarrow q) \equiv (p \Rightarrow q) \wedge (q \Rightarrow p)$ ); identity ( $p \equiv p$ ); law of negation ( $\sim(\sim p) \equiv p$ ); law of excluded middle ( $p \vee \sim p \equiv \text{true}$ ); law of contradiction ( $p \wedge \sim p \equiv \text{false}$ ); tautology and contingency simplification rules for  $\wedge$ ,  $\vee$ . Converse, inverse and contra positive. Chain rule, Modus ponens.*

- (b) Binary valued quantities; basic postulates of Boolean algebra; operations AND, OR and NOT; truth tables.
- (c) Basic theorems of Boolean algebra (e.g. duality, idempotence, commutativity, associativity, distributivity, operations with 0 and 1, complements, absorption, involution); De Morgan's theorem and its applications; reducing Boolean expressions to sum of products and product of sums forms; Karnaugh maps (up to four variables).

*Verify the laws of Boolean algebra using truth tables. Inputs, outputs for circuits like half and full adders, majority circuit etc., SOP and POS representation; Maxterms & Minterms, Canonical and Cardinal representation, reduction using Karnaugh maps and Boolean algebra.*

#### 2. Computer Hardware

- (a) Elementary logic gates (NOT, AND, OR, NAND, NOR, XOR, XNOR) and their use in circuits.
- (b) Applications of Boolean algebra and logic gates to half adders, full adders, encoders, decoders, multiplexers, NAND, NOR as universal gates.

*Show the correspondence between Boolean methods and the corresponding switching circuits or gates. Show that NAND and NOR gates are universal by converting some circuits to purely NAND or NOR gates.*

### SECTION B

The programming element in the syllabus (Sections B and C) is aimed at algorithmic problem solving and **not** merely rote learning of Java syntax. The Java version used should be 5.0 or later. For programming, the students can use any text editor and the javac and java programs or any other development environment: for example, BlueJ, Eclipse, NetBeans etc. BlueJ is strongly recommended for its simplicity, ease of use and because it is very well suited for an 'objects first' approach.

### 3. Implementation of algorithms to solve problems

The students are required to do lab assignments in the computer lab concurrently with the lectures. Programming assignments should be done such that each major topic is covered in at least one assignment. Assignment problems should be designed so that they are sufficiently challenging. Students must do algorithm design, address correctness issues, implement and execute the algorithm in Java and debug where necessary.

*Self explanatory.*

### 4. Programming in Java (Review of Class XI Sections B and C)

*Note that items 4 to 13 should be introduced almost simultaneously along with classes and their definitions.*

*While reviewing, ensure that new higher order problems are solved using these constructs.*

### 5. Objects

- (a) Objects as data (attributes) + behaviour (methods); object as an instance of a class. Constructors.
- (b) Analysis of some real-world programming examples in terms of objects and classes.
- (c) Basic input/output using Scanner and Printer classes from JDK; input/output exceptions. Tokens in an input stream, concept of whitespace, extracting tokens from an input stream (String Tokenizer class).

### 6. Primitive values, Wrapper classes, Types and casting

Primitive values and types: byte, int, short, long, float, double, boolean, char. Corresponding wrapper classes for each primitive type. Class as type of the object. Class as mechanism for user defined types. Changing types through user defined casting and automatic type coercion for some primitive types.

### 7. Variables, Expressions

Variables as names for values; named constants (final), expressions (arithmetic and logical) and their evaluation (operators, associativity, precedence). Assignment operation; difference between left hand side and right hand side of assignment.

### 8. Statements, Scope

Statements; conditional (if, if else, if else if, switch case, ternary operator), looping (for, while, do while, continue, break); grouping statements in blocks, scope and visibility of variables.

### 9. Methods

Methods (as abstractions for complex user defined operations on objects), formal arguments and actual arguments in methods; different behaviour of primitive and object arguments. Static method and variables. The **this** Operator. Examples of algorithmic problem solving using methods (number problems, finding roots of algebraic equations etc.).

### 10. Arrays, Strings

Structured data types – arrays (single and multi-dimensional), address calculations, strings. Example algorithms that use structured data types (e.g. searching, finding maximum/minimum, sorting techniques, solving systems of linear equations, substring, concatenation, length, access to char in string, etc.).

*Storing many data elements of the same type requires structured data types – like arrays. Access in arrays is constant time and does not depend on the number of elements. Address calculation (row major and column major), Sorting techniques (bubble, selection, insertion). Structured data types can be defined by classes – String. Introduce the Java library String class and the basic operations on strings (accessing individual characters, various substring operations, concatenation, replacement, index of operations). The class StringBuffer should be introduced for those applications that involve heavy manipulation of strings.*

### 11. Recursion

Concept of recursion, simple recursive methods (e.g. factorial, GCD, binary search, conversion of representations of numbers between different bases).

*Many problems can be solved very elegantly by observing that the solution can be composed of solutions to ‘smaller’ versions of the same problem with the base version having a known simple solution. Recursion can be initially motivated by using recursive equations to define certain methods. These definitions are fairly obvious and are easy to understand. The*

definitions can be directly converted to a program. Emphasize that any recursion must have a base case. Otherwise, the computation can go into an infinite loop.

The tower of Hanoi is a very good example of how recursion gives a very simple and elegant solution where as non-recursive solutions are quite complex.

## SECTION C

### Inheritance, Interface, Polymorphism, Data structures, Computational complexity

#### 12. Inheritance, Interfaces and Polymorphism

- (a) Inheritance; super and derived classes; member access in derived classes; redefinition of variables and methods in subclasses; abstract classes; class Object; protected visibility. Subclass polymorphism and dynamic binding.

*Emphasize inheritance as a mechanism to reuse a class by extending it. Inheritance should not normally be used just to reuse some methods defined in a class but only when there is a genuine specialization (or subclass) relationship between objects of the super class and that of the derived class.*

- (b) Interfaces in Java; implementing interfaces through a class; interfaces for user defined implementation of behaviour.

*Motivation for interface: often when creating reusable classes some parts of the exact implementation can only be provided by the final end user. For example, in a class that sorts records of different types the exact comparison operation can only be provided by the end user. Since only he/she knows which field(s) will be used for doing the comparison and whether sorting should be in ascending or descending order be given by the user of the class.*

*Emphasize the difference between the Java language construct interface and the word interface often used to describe the set of method prototypes of a class.*

#### 13. Data structures

- (a) Basic data structures (stack, queue, circular queue, dequeue); implementation directly through classes; definition through an interface and multiple implementations by

implementing the interface. Conversion of Infix to Prefix and Postfix notations.

*Basic algorithms and programs using the above data structures.*

*Data structures should be defined as abstract data types with a well-defined interface (it is instructive to define them using the Java interface construct).*

- (b) Single linked list (Algorithm and programming), binary trees, tree traversals (Conceptual).

*The following should be covered for each data structure:*

*Linked List (single): insertion, deletion, reversal, extracting an element or a sublist, checking emptiness.*

*Binary trees: apart from the definition the following concepts should be covered: root, internal nodes, external nodes (leaves), height (tree, node), depth (tree, node), level, size, degree, siblings, sub tree, completeness, balancing, traversals (pre, post and in-order).*

#### 14. Complexity and Big O notation

Concrete computational complexity; concept of input size; estimating complexity in terms of methods; importance of dominant term; constants, best, average and worst case.

*Big O notation for computational complexity; analysis of complexity of example algorithms using the big O notation (e.g. Various searching and sorting algorithms, algorithm for solution of linear equations etc.).*

### PAPER II: PRACTICAL – 30 MARKS

This paper of three hours' duration will be evaluated by the Visiting Examiner appointed locally and approved by the Council.

The paper shall consist of three programming problems from which a candidate has to attempt any one. The practical consists of the two parts:

1. Planning Session
2. Examination Session

The total time to be spent on the Planning session and the Examination session is three hours. A maximum of 90 minutes is permitted for the Planning session and 90 minutes for the Examination session.

**Candidates are to be permitted to proceed to the Examination Session only after the 90 minutes of the Planning Session are over.**

**Planning Session**

The candidates will be required to prepare an algorithm and a hand written Java program to solve the problem.

**Examination Session**

The program handed in at the end of the Planning session shall be returned to the candidates. The candidates will be required to key-in and execute the Java program on seen and unseen inputs individually on the Computer and show execution to the Visiting Examiner. A printout of the program listing including output results should be attached to the answer script containing the algorithm and handwritten program. This should be returned to the examiner. The program should be sufficiently documented so that the algorithm, representation and development process is clear from reading the program. Large differences between the planned program and the printout will result in loss of marks.

Teachers should maintain a record of all the assignments done as part of the practical work through the year and give it due credit at the time of cumulative evaluation at the end of the year. Students are expected to do a **minimum of twenty-five** assignments for the year.

**EVALUATION:**

Marks (out of a total of **30**) should be distributed as given below:

**Continuous Evaluation**

Candidates will be required to submit a work file containing the practical work related to programming assignments done during the year.

Programming assignments done throughout the year (Internal Evaluation)	10 marks
Programming assignments done throughout the year (Visiting Examiner)	5 marks

**Terminal Evaluation**

Solution to programming problem on the computer	15 Marks
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Marks should be given for choice of algorithm and implementation strategy, documentation, correct output on known inputs mentioned in the question paper, correct output for unknown inputs available only to the examiner.

**NOTE:**

Algorithm should be expressed clearly using any standard scheme such as a pseudo code.

**EQUIPMENT**

There should be enough computers to provide for a teaching schedule where at least three-fourths of the time available is used for programming.

Schools should have equipment/platforms such that all the software required for practical work runs properly, i.e. it should run at acceptable speeds.

Since hardware and software evolve and change very rapidly, the schools may have to upgrade them as required.

Following are the recommended specifications as of now:

**The Facilities:**

- A lecture cum demonstration room with a MULTIMEDIA PROJECTOR/ an LCD and O.H.P. attached to the computer.
- A white board with white board markers should be available.
- A fully equipped Computer Laboratory that allows one computer per student.
- Internet connection for accessing the World Wide Web and email facility.
- The computers should have a minimum of 1 GB RAM and a P IV or higher processor. The basic requirement is that it should run the operating system and Java programming system (Java compiler, Java runtime environment, Java development environment) at acceptable speeds.
- Good Quality printers.

**Software:**

- Any suitable Operating System can be used.
- JDK 6 or later.
- Documentation for the JDK version being used.
- A suitable text editor. A development environment with a debugger is preferred (e.g. BlueJ, Eclipse, NetBeans). BlueJ is recommended for its ease of use and simplicity.

**SAMPLE TABLE FOR PRACTICAL WORK**

S. No.	Unique Identification Number (Unique ID) of the candidate	Assessment of Practical File		Assessment of the Practical Examination (To be evaluated by the Visiting Examiner only)				TOTAL MARKS (Total Marks are to be added and entered by the Visiting Examiner)  30 Marks
		Internal Evaluation 10 Marks	Visiting Examiner 5 Marks	Algorithm	Java Program with internal Documentation	Hard Copy (printout)	Output	
				3 Marks	7 Marks	2 Marks	3 Marks	
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Name of the Visiting Examiner: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

# GEOMETRICAL AND BUILDING DRAWING (870)

**This subject may not be taken with Geometrical and Mechanical Drawing.**

Candidates will be required to reach a minimum standard in the subject as a whole. The use of drawing board, tee-square and set-squares will be required. (Candidates may, if they wish, use a drawing board fitted with parallel motion straight

edge. The use of drafting machines will be permitted). A2 size paper will be used. The recommendations of IS:962-1972 Indian Standard, Code of Practice for Architectural and Building Drawings should be followed.

The use of models is to be encouraged in studying this syllabus.

## CLASS XI

*There will be two papers in the subject:*

**Paper I - Theory: 3 hours..... 80 Marks**

**Paper II - Project Work ..... 20 Marks**

### **PAPER I (THEORY): 80 Marks**

#### **SECTION A**

##### **Plane Geometry**

Construction and use of scales including diagonal scales. Enlargement and reduction of irregular plane figures. Construction of triangles, quadrilaterals and polygons. Similar plane figures. Problems on circles, tangents and normals. Loci such as the paths of points in simple link mechanisms. Methods of construction of ellipse, including its elementary properties, parabola and rectangular hyperbola: cycloidal and involute curves.

#### **SECTION B**

##### **Solid Geometry**

Orthographic projection. (Diagrams printed in the question papers may be either First or Third Angle projections; the projection used will be stated. Solutions in either First or Third Angle projections will be accepted).

Projection involving use of auxiliary planes: simple problems on auxiliary projection. Simple problems on the intersection of prisms, pyramids, cylinders, right circular cones, and spheres. Determination of true length of a line in space: sections and surface development of prisms, pyramids, cylinders and right circular cone. Helix treated as a locus with applications on the projection of helices. Isometric and oblique projection without the use of isometric scales.

### **PAPER II (PROJECT WORK): 20 Marks**

In addition to the syllabus prescribed above, candidates are also required to be assessed in Project Work.

All candidates will be required to have completed **two projects** from any topic/s covered in theory. The Project work is to be assessed by the subject teacher. For details refer to Class XII.



## CLASS XII

There will be two papers in the subject

**Paper I - Theory:** 3 hours..... 80 Marks

**Paper II - Project Work** ..... 20 Marks

### PAPER I (THEORY): 80 Mark

#### Building Drawing

Candidates will be required to answer **all** questions.

The course on Building Drawing should be based on the form and construction of simple buildings and parts of buildings; small dwelling houses (single and two storey), garages, sheds and green houses.

Orthographic projection in either First or Third Angle projection, including sectional views of buildings and parts of buildings and building details, e.g. foundations, walls (including openings), jambs, sills,

lintels and arches, floors and roofs, doors and windows, simple stairs.

Preparation of simple working drawings and details from free-hand sketches.

Free-hand sketching on both orthographic and pictorial form of simple building details and tools used in the various building crafts and school workshops such as hammer, mallet, tri - square, plane chisel, trowel, screwdriver and the like.

Drawing paper (folded) will be provided but candidates may use any type of drawing paper for answering the question provided it is of suitable quality and of the correct size.

### PAPER II (PROJECT WORK): 20 Marks

In addition to the syllabus prescribed above, candidates are also required to be assessed in Project Work.

The Project work is to be assessed by the subject teacher and the Visiting Examiner appointed locally and approved by the Council.

All candidates will be required to have completed **two** projects from any topic/s covered in theory.

#### Assessment Criteria for different types of Projects

**Theory Based Project: Mark allocation for each project (10 marks)\*:**

S. No.	Criteria	Marks
1.	Title of the Project and Introduction	1
2.	Content	3
3.	Presentation and originality	2
4.	Conclusion/Comments/Summary	1
5.	Viva-Voce (Visiting Examiner)	3
	<b>Total</b>	<b>10</b>

**Model Based Project: Mark allocation for each project (10 marks)\*:**

S. No.	Criteria	Marks
1.	Title of the Project	1
2.	Model construction	4
3.	Concise Project report	2
4.	Viva-Voce (Visiting Examiner)	3
	<b>Total</b>	<b>10</b>

**Sketching Based Project: Mark allocation for each project (10 marks)\*:**

S. No.	Criteria	Marks
1.	Annotations	3
2.	Line weights	4
3.	Viva-Voce (Visiting Examiner)	3
	<b>Total</b>	<b>10</b>

**List of suggested assignments for Project Work:**

#### 1. Model Making:

Make a Study model to Scale, selecting any topic from the syllabus. Example:

- Scaled model of Small Residence
- Detailed model of Staircase
- Model demonstrating different types of roofs

## 2. Market Survey on Building Materials (Online/offline):

Conduct a market survey of selected building materials which are commonly used in construction along with their rates. Collect samples/pictures of **any 5** building materials used (e.g.: Bricks, Wood & Wood Finishes, Flooring, Doors & Windows materials). Prepare a report including:

- The findings of your Market Survey, along with samples/pictures of building materials collected.
- Factors to be kept in mind while selecting building materials.
- Innovation in technologies and other global factors leading to a rapid change in building materials.

## 3. Site Study/Desktop Study:

Select a site (It could be a site which is under construction, a completed project such as an apartment, bungalow, independent villa, interiors of a residence or a project online, etc.). Visit the selected site to understand the type of construction, the materials used and the architectural or interior design.

Prepare a project report highlighting your observations and findings along with site pictures.

## 4. Sketching:

Develop ten free hand sketches of buildings and their details. Examples:

- Door & Window details
- Types of bricks
- Isometric views of building or their details
- Plan & Section details
- One point or two-point perspectives

## 5. Working Drawings:

Prepare two simple working drawings (manually) for any project, including sectional views of buildings and parts of buildings along with building details, with lineweights, e.g.: Civil Drawings, Sections & Elevations, etc.

Students must be given sample working drawings for reference and asked to draft manually with lineweights (This exercise will help students understand the role of consultants who prepare different types of working drawings).

Example: Foundations, walls including openings, jambs, sill, lintels, arches, floors, roofs, doors and windows & simple stairs.

## 6. Research Study:

Study any one of the following topics and present your findings in the form of a report (giving a few examples of projects) **OR** prepare a Powerpoint presentation (of not less than 15 slides) on the same.

- Contemporary/Modern Architecture
- Sustainable Architecture
- Traditional Architecture
- Art Deco
- Brutalist Architecture

## 7. Precedent Study - Indian Architecture:

Conduct a deep and extended study on an **Indian Architect** (e.g. - Charles Correa, B.V. Doshi, Raj Rewal, Laurie Baker, etc.). Prepare a report giving examples of the projects done by the architect, along with images & sketches **OR** prepare a Powerpoint presentation (of not less than 15 slides) on the same.

### SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	<u>PROJECT 1</u>					<u>PROJECT 2</u>					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva- Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)	
		7 Marks	7 Marks	7 Marks	3 Marks	10 Marks	7 Marks	7 Marks	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

\*For breakup of the 7 Marks to be awarded separately by the Teacher and the Visiting Examiner, please refer to the table giving the criteria for mark allocation for *each* project.

**NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner and should be based on the Project only.**

## ART (871)

### Aims:

1. To encourage creative expression in and through Art.
2. To develop the powers of aesthetic appreciation.
3. To develop an artistic attitude and values through the study of art.
4. To develop an interest in the world of art.

### CLASSES XI & XII

Candidates will be required to take **three papers**, of 100 Marks each, including at least **one paper** from Section A and at least **one paper** from Section B.

Papers 1-3 form Section A. Papers 4-6 form Section B.

Papers 1-5 shall be of three hours duration each.

Paper 6 (Craftwork) will be assessed by a Visiting Examiner appointed locally. No question paper shall be set by the Council for Paper 6.

Success or failure will depend on a candidate's performance in the subject as a whole.

#### SECTION A

##### **Paper 1: (3 hours), Drawing or Painting from Still Life**

A group of objects which will be artificial and natural and may include such things as cut flowers, fruits, vegetables, a growing plant, as well as domestic or other artificial objects; the group may be drawn or painted. The work can be carried out, if the candidate wishes, in relation to the surroundings of the part of the room in which the group is placed. If the group is painted, the background must be included.

##### **Paper 2: (3 hours), Drawing or Painting from Nature**

This paper is divided into two separate sections. Candidates may offer either A or B. In both sections, the subject may be interpreted freely, either in a decorative or in a realistic manner.

- A. Study of the structure of natural forms such as a spray or branch, which may include flowers; foliage or fruit; fossils, bones, etc. Candidates are expected to reveal their appreciation of natural growth or structure by means of drawing or painting.
- B. A subject will be set for drawing or painting outdoors. There should be evidence of direct study from nature.

##### **Paper 3: (3 hours), Drawing or Painting of a Living Person**

Two alternatives will be given. In alternative (A) the model (who may be a boy, girl, man or woman) is to be placed in an attitude which will be described. The whole figure must be drawn, together with any necessary artificial or natural objects. If the subject is painted, the model must be seen against a suitable background. Clothing should be simple and the limbs exposed as much as possible.

Alternative (B) will be mainly a study of the head but may include the arms and hands. Instructions for each examination will be given. Candidates should be placed closer to the model than for Alternative (A).

If candidates consider that they have completed their drawings before the end of the examination period, they may make a separate study. Candidates taking Alternative (A) may choose head, hands or other details. Those taking Alternative (B) may draw the portrait from another position or make a study of a part of the head or the hands.

In either (A) or (B) the second drawing may be made on the same sheet or paper or on another sheet, which must be attached. Candidates are to be told that the two drawings will be considered together and that marks will not be lost if a second drawing is not attempted.

#### SECTION B

##### **Paper 4: (3 hours), Original Imaginative Composition in Colour**

A paper containing a list of alternative subjects will be given to candidates one week before the examination. The actual composition will be executed in the examination room after a period of not less than seven days from the distribution of the paper to the candidates; sketches, or other notes must not be taken into the examination room. Since this is

a test of original work, it would be inappropriate for any form of guidance to be given to candidates other than that printed on the question paper. A variety of themes will be set; these may be given in the form of titles indicating the subjects, or of specified objects for inclusion in a composition, or in any other form that will stimulate the imagination. Candidates should base their work if possible on scenes that they have themselves observed. Any style, or technique, including that which is traditional in the candidates' own area, may be used.

### **Paper 5: (3 hours), Crafts 'A'**

Candidates will be required to answer any one question. The object of this paper is to test the ability of candidates in craftwork where the material is restricted to flat paper, ink and/or colour. Question will be set requiring the design and execution of the following:

- the page of a book, book cover, or end papers;
- a notice or pictorial poster;
- a card such as a Christmas card or invitation card or emblem;
- a patterned paper for a specific purpose.

Several but not all of these alternative subjects will be set and candidates will be required to select any one of them. There will be an opportunity to make full use of the calligrapher's art with drawn and painted, pen-made or brush-written lettering.

### **Paper 6: Crafts 'B'**

This Paper is restricted to school candidates.

The candidates must submit at least one and *not more than two* examples of Craftwork, which they have executed during the school year in any one craft from the following eight categories. Further evidence of study in the form of working drawings, small notebook or photographs may also be submitted.

- (a) Earthenware or stoneware pottery such as a jug, bowl, dish, vase or hollowed pottery form which the candidate has either moulded, hand built or thrown on the wheel and decorated if he or she so wishes.
- (b) Abstract or figurative sculpture including reliefs. These can be carved, constructed, assembled, cast or modelled in any suitable material.

Candidates must be warned not to submit work in material that is likely to break in transit; clay must always be fired and modelling in plaster must be supported by strong armatures. Sculpture over 60 cm in any dimension is not acceptable because of difficulties in handling.

- (c) Cloth or rug designed and woven by the candidate on the loom for any specified purpose. When possible this should show experience of spinning and dyeing.
- (d) Cotton, wool, silk, bark cloth or other material dyed in a pattern as in block-printing, screen-printing, batik, tie-and dye, etc. The piece should be at least a square metre in area. Blocks should not be sent.
- (e) Embroidery, mosaic, collage or decorative panels, unframed, but simply and suitably mounted, showing evidence of ability to relate design to media.
- (f) Puppet or marionette (including the type used in shadow plays) representing a specified character or person. It is desirable that the puppets should be made in relation to a play, and notes on their particular dramatic use should be included.
- (g) Prints in colour or black and white, from an original wood or lino block or a monotype. The main work must be clearly labelled and suitably mounted. Blocks need not be sent.
- (h) Example of a local craft made by the candidate. This should be supported by a second entry showing a personal development of this craft.

### **Each candidate must confine his entry to ONE craft.**

The work submitted must be the unaided work of the candidate. It must be accompanied by a statement from the Principal of the school to this effect.

### **GENERAL**

1. Any medium may be used provided that it is suitable for the subject. Painted work must be carried out in a quick-drying medium and must be completely dry before it is dispatched. When acrylic paint is used for examination work, it must be mixed with water. All paints used must be of adequate quality: if coloured crayons or chalk are used, they must have a range and quality comparable with that of paints and must

be carefully fixed at the examination centre before the work is sent to the Council. Monochrome may be used where permitted by the regulations for each Paper but will not be accepted as satisfying the requirement in respect of colour for Paper 4.

2. Candidates must use their judgment with regard to (i) the size of a drawing or painting, (ii) the proportion of height to width within the space available. In all cases credit will be given for good composition.
3. In each of Papers 1 to 4, the test is one of free drawing or painting, therefore, any mechanical means of execution of the drawing or painting, (such as measuring or ruling) are not allowed. Instruments and tracing paper are allowed for Paper 5, but candidates are advised to restrict their use as far as possible.
4. Where question or printed instructions are provided for alternative groups, etc., the Supervising Examiner in consultation with an Art Teacher will decide which of these alternatives is to form the subject of the examination, after taking account of local convenience, etc. At centres for candidates from more than one school, both the alternative subjects in Paper 2 (Plant Drawing) must be provided if they are required by schools or candidates.
5. Suitable alternative subjects will be provided for the different areas, so far as this may appear desirable; account will be taken of different climatic conditions in the selection of flower specimens, etc.
6. The paper supplied for use in the examination room will be about 35 cm x 25 cm. Schools or candidates wishing to work on a larger scale, not larger than Half Imperial or Royal (64 cm x 51 cm) or on a different type or tone of paper, will be at liberty to provide their own. Work which is carried out on stiff boards or which is mounted cannot be accepted. The paper used by candidates must not be less than 35 cm x 25 cm and the work submitted must fill or approximately fill the page.
7. **All drawings must be packed flat and not rolled:** Half-Imperial and Royal sheets should be folded across the middle. When drawings are too large to enclose in the envelopes provided, it is

essential that the information required on the front of the envelope be given and that the envelope itself be packed in the same parcel with the drawings.

8. Examiners are caused great inconvenience by candidates failing to write their examination numbers either clearly or correctly, thus making identification difficult. Schools are asked to cooperate by directing the candidates to clearly write their Unique Identification Number (UID Number) and Index Number both, clearly and correctly on their examination work and that on drawings and paintings this must be written on the front (top right hand corner) and also on the back. They must not write anything else on the front of the picture. Failure to observe this instruction may result in loss of marks.

## **STANDING INSTRUCTIONS FOR SUPERVISING EXAMINERS**

### **Papers 1-3**

The printed 'Instructions' for these papers which are sent to schools well in advance of the examination will be limited as far as possible to the subjects of the tests. They are for the use of the Supervising Examiner only, in consultation with the Art Teacher.

It is important that early attention should be given to the provision of the objects and / or models required. In papers 1 to 3, both alternatives must be set if required by candidates.

The group or subject should be so arranged that each candidate obtains an uninterrupted view: for Paper 1 candidates should not be more than 3.60 meters from the group. Candidates may form a semicircle but not a complete circle round the group; more than one session may be arranged if there is a large number of candidates. The examination must be held in good light but care must be taken that sunlight does not fall upon the group or subject while work is in progress. If the group or subject is painted, the background must be included.

The surface on which the group of objects for Paper 1 and the group for painting only in Paper 2 is arranged must be below the eye level of the candidates.

### **Drawing or Painting from Still Life**

This is a test of direct observation and free drawing. Both themes as given in the question paper should be

set by the art teacher and the candidates should select the theme they want to attempt. Proper space and seating arrangements must be provided to enable the candidates to draw and colour their desired option.

In the setting of the objects of the theme, care must be taken to ensure that each item is visible either fully or partially to all candidates.

Care must be taken by the art teacher in selection of the objects. They should not be unnecessarily complicated in shape or have complex patterns or labels over and above the basic requirements.

### **Drawing or Painting from Nature**

#### ***Alternative A: Study of the structure of natural forms***

It is desirable that each candidate be given a separate specimen and be permitted to handle and arrange it.

If the specimens named in the Instructions are not available, Supervising Examiners may, with the assistance of the Art Teacher, substitute other specimens as similar as possible to those, which have been set. The name of the specimen used must be stated on the back of the drawing in small block capitals.

Sprays, when these are set, must be reasonably large and full and in good condition; they should be displayed in a vase or bottle and be clearly visible against a plain background. The container must not be drawn.

#### ***Alternative B: Drawing or painting outdoors***

One subject will be set for painting or drawing outdoors. It can include a study of plants, creepers or climbers growing against walls, pergolas, rockeries and other such features. Plants grown in pots and containers which can be kept indoors can be set. There should be evidence to understand the general characteristic and growing habit of the subject as it grows in its natural environment.

### **Drawing or Painting of a Living Person**

The Supervising Examiner should avail himself of the services of the Art Teacher for posing the model and for re-posing after the model has been resting.

Five minutes will be allowed for the model to relax after each twenty minutes' posing. During these intervals candidates may continue to work on their drawings. The Supervising Examiners may vary the length of the posing periods and of the intervals at their discretion. The period of 2 or 3 hours includes the time during which the model is resting.

Two models must be provided if Alternatives A and B are required by different candidates at the same session. If more than one model is employed for either A or B, this should be stated on the answer envelope.

The model is to be posed in good light and shade. Candidates must be so placed that each has a good view of the pose.

### **Original Imaginative Composition in Colour**

Copies of the Paper are to be given to the candidates at least a week before the paper is taken in the examination room and candidates should be instructed to bring their copies of the question paper with them at the time fixed for this paper.

#### **‘Crafts A’**

At centres where the necessary arrangements can be made, candidates may cut and print from a block in the examination room. Folded and cut-out paper may be used in making designs. Collage may be used.

#### **Paper 6 (Craftwork)**

The specimens of Craftwork should not be dispatched to the Council. Pieces of pottery, sculpture or carving must not exceed 1m in any dimension nor weigh more than 18 kg. Craftwork submitted for one examination must not be submitted for a subsequent one. This paper is to be assessed by a Visiting Examiner appointed locally.

# PHYSICAL EDUCATION (875)

## Aims:

1. To gain an understanding and insight into the modern and emerging concepts as well as future prospects of Physical Education.
2. To create awareness of the necessity for vigour and efficiency through physical fitness.
3. To facilitate physical, intellectual, emotional and social development of students.
4. To develop an understanding of the physiological, socio-cultural and psychological factors which influence Physical Education.
5. To create awareness of the necessity to develop a good posture and physical poise.
6. Give special attention to physically challenged children.
7. To create opportunities to develop *esprit de corps*, courtesy, sportsmanship, social skills, democratic conduct and ideals.
8. To develop skills of planning as well as practical skills in order to perform effectively.
9. To develop the ability to relate practice to classroom learning and vice-versa.

## CLASS XI

There will be **two** papers in the subject:

**Paper I:** Theory: 3 hours -----70 marks

**Paper II:** Practical Work ----- 30 marks

### PAPER I (THEORY) – 70 Marks

The theory paper will be divided into **two** Sections A and B. Candidates will be required to answer **five** questions out of **seven** from **Section A**, each carrying **8 marks**. **Section B** will be based on questions on major games in the syllabus. Candidates will be required to select **two games** from this section and answer any **three** of the **five** subparts (a), (b), (c), (d) and (e) from **each** of the **two** selected games of their choice. Each question shall carry **15 marks**.

**Note:** Details regarding evaluation of Practical Work are given at the end of Class XII. Practical Evaluation for Class XI is to be done by the Internal Examiner.

### SECTION – A

#### 1. Concept of Physical Education

- (i) Meaning of Physical Education, its aim and objectives.

*Understanding of the term 'Physical Education'. Aims and objectives of Physical Education*

Importance of Physical Education.

*Need for Physical Education and how it is important.*

- (ii) Misconceptions about Physical Education and the relevance of Physical Education in the inter-disciplinary context (sports medicine, sports engineering, sports psychology, sports journalism, sports physiotherapy, sports nutritionist, sports fashion designing).

*Misconceptions with respect to Physical Education; how Physical Education is related to various other disciplines as listed above.*

- (iii) Meaning of 'Play' and 'Recreation'.

*Definition and importance of 'Play'; Characteristics of Play (freedom and time, space and spontaneity, enjoyment, intrinsic value).*

*Definition and importance of recreation.*

- (iv) Meaning and concept of 'Games and Sports'.

*Meaning, definition and characteristics of 'Games and Sports'*

#### 2. Individual Aspects and Group Dynamics

- (a) Interest and attitude.

– *Meaning and definition of the term Interest (inborn and acquired); Methods of developing interest (in Physical Education activities and programmes).*

– *Meaning and definition of the term Attitude (experience, derived, emotional challenge, profession); methods of*



*forming attitude: by means of suggestions, by blindly accepting the social norms, by means of some intense emotional experiences, through participating in games and sports (forming attitude to win, attitude towards exercise, attitude towards physical fitness, fair play, obedience, discipline, etc.)*

(b) Motivation.

- *Introduction, meaning and definition of 'Motivation'.*
- *Types of Motivation: intrinsic and extrinsic.*
- *Methods of Motivation: praise or blame, competition, reward and punishment, setting clear goals, success and failure, record of progress, scholarships, social recognition, honour and glory.*

(c) Leadership.

- *Meaning and definition of the word 'Leader'.*
- *Desirable qualities of a Leader.*

### 3. Effects of Physical Exercise on Human Body Systems

Various systems and the effects of exercise and training on the following: skeletal system, muscular system, respiratory system, circulatory system and digestive systems.

- (i) *The skeletal and muscular system: Types of bones in the body, various types of joints and major movements; structural classification of muscles, structure and function of muscle.*
- (ii) *Respiratory System: Meaning and types of respiration, organs of the respiratory system (nose, larynx, trachea, bronchi, diaphragm) and their functions.*
- (iii) *Circulatory system: Meaning; Heart, its structure and functions; control of the heart rate; function and composition of blood, maintenance of blood supply.*
- (iv) *Digestive System: Meaning, major organs (mouth, oesophagus, stomach, pancreas,*

*liver, gallbladder, small intestine, large intestine) and functions of each.*

- (v) *Effect of exercise and benefits of regular training on the above systems.*

### 4. Nutrition, Weight Control & Exercise

- (i) Nutrition Basics – Dietary Goals and basics of a Nutritious Diet.

*Nutrition basics: Dietary Goals for various stages of growth (childhood, adolescence, adulthood, old age); Meaning of 'Nutritious Diet'.*

- (ii) Balanced Diet and role of balanced diet in performance.

*Concept of a Balanced diet; elements and sources of a balanced diet; factors affecting balanced diet; Importance of Balanced diet in sports performance.*

- (iii) Obesity and weight control; Life time concept of weight control.

*Meaning and definition of obesity; causes of Obesity, dangers of Obesity, prevention of Obesity through exercise and weight control.*

*Life-time concept of weight control – an understanding of how weight can be controlled through proper eating habits and exercise.*

### 5. Physical Fitness & Wellness

- (i) Physique, Physical Fitness and Wellness.

*Understanding of the term 'Physique'; A basic understanding of the three body types (a) Endomorph (b) Mesomorph (c) Ectomorph.*

*Meaning and importance of Physical Fitness and Wellness.*

- (ii) Components of physical fitness and wellness.

*Components of physical fitness:*

*Health related fitness such as Cardio vascular endurance, muscular endurance, strength; flexibility; body composition.*

*Skill related fitness: such as Cardio vascular endurance, muscular endurance, strength; flexibility; body composition, balance;*

*coordination; agility; power, reaction time and speed (Candidates should be made to understand that skill related fitness includes all health related fitness components).*

*Components of Wellness: social, spiritual, physical, mental, emotional and intellectual (a basic understanding of each).*

- (iii) Factors affecting physical fitness and wellness.

*Factors affecting physical fitness and wellness: Heredity, exercise (physical, mental and social benefits), illness, physical deformity, age and gender, diet, stress, living style, substance use (smoking, drugs, alcohol) and environment.*

- (iv) Tests and Measurements in Sports.

*Basic understanding, importance and calculation of the following: Kraus Weber Test; Body Mass Index (BMI); Waist Hip Ratio; Measurement of Heart Rate; Rockport one-mile test.*

## 6. Games and Sports – a global perspective

- (i) Olympics as a Social force.

*An understanding of how the Olympic games promote international understanding and appreciation of cultural diversity by providing a platform for athletes from all over the world to meet and compete, irrespective of their colour, race, creed and political beliefs.*

- (ii) History of Modern Olympics.

*Motto of the Olympic games; Events held in modern Olympics; Where and when the first modern Olympics took place and where and when the upcoming Olympics will take place; significance of the colours used in the rings of the Olympic flag and what these rings signify. The founder of modern Olympics.*

- (iii) Asian Games.

*Where and when the first Asian Games took place and where and when the upcoming Asian Games will take place. Events held in Asian Games; Countries participating in Asian Games.*

## SECTION B

Any **two** of the following games are to be studied:

Cricket, Football, Hockey, Basketball, Volleyball, Badminton, Tennis, Swimming, Athletics.

The following aspects should be studied for **each** of the **two games** selected by the candidate.

Rules and regulations of the game; Interpretation of laws of the game; Duties and responsibilities of the officials and players; Measurement and dimensions related to the game; Terminologies related to the game; Fundamental skills of the game; Strategies and formation of the game; Names and abbreviations of the National and Major International Tournaments linked with the game; Diagrams and dimensions of play area; Diagrams and dimensions of equipment related to the game.

The details for each game are given below:

### CRICKET

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Diagrams of the field and pitch, and various fielding positions.
- Knowledge of the dimensions of the field, thickness of the lines, dimensions of pitch and complete specifications and markings on it. Equipment of the game with their length, width weight, thickness and material. Score board, scorer, sight screen. Flood light
- Duties of the officials, before, during and after the match. Umpires and third umpire, requirements of the game, equipment needed, numbers of players, duty of coach, captain etc.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, forfeitures, follow on, tie, power play, match fixing, duck worth rule, sledging, ball tampering.
- Basic skills and techniques. Batting (different types of shots, footwork, body position and actual bat movement. Bowling (run up, delivery stride, follow through, types of bowling variations, good line and length, grip action. Fielding positions, catching and throwing skills, Wicket keeping techniques, skills of getting the batsmen out.

- Different types of signals, extra runs, extra players, runner, substitute, provisions and restrictions, players equipment, danger area, various terms of cricket.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **FOOTBALL**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie breaker, sudden death, ball in play and out of play, importance of lines on the field. Various methods of starting and restarting the game. Substitution procedure, penalty cards and their importance.
- Knowledge of the dimensions of the field, thickness of the lines, dimensions of center circle, quarter circle, goal and penalty area, penalty arc and complete specifications and markings on it. Equipment of the game with their length, width, weight, thickness, material and dimensions. Diagram of goal post and field.
- Duties of the officials, requirements of the game, equipment needed, numbers of players, duty of coach, captain, assistant referees, technical officials, grounds men, ball boys, match organizers, technical area.
- Laws governing the game. Suspensions, penalizations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches.
- Basic skills and techniques (Passing - types of pass, ground lofted, chip, volley, angle of pass. Control (use of various surfaces-head chest, foot thigh). Dribbling (running with the ball, rhythm and pace, feints, body swerves, screening, beating an opponent. Heading the ball with intention of (attacking, defending, jumping, to head down, high, pass, score). Shooting skills with either foot, inside or outside, short and long range shots, swerving shots, volleys, penalty kicks, power and accuracy. Tackling skills - interception, jockeying for the ball, trapping by various body parts, position, tackle front, side,

slide, recovery. Goalkeeping skills - stopping, watching, guiding the team, saving goal, dealing, catching, heading, kicking, punching, throwing, diving, anticipation, speed and reflexes.

- Principles of play-attack, depth, defence, penetration, sweeper systems, 4-4-2, 4-3-3, 4-2-4. Kick-off, corner kick, throw-in, goal kick, free kick, penalty kick. Importance of penalty arc, center circle and lines on the field.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **HOCKEY**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie breaker, sudden death, ball in play and out of play, penalty stroke, short corner, long corner, free hits, hit or push back, 16 yard hit, importance of lines on the field. Start and restart of the match.
- Knowledge of the dimensions and diagrams of the field and goalpost, thickness of the lines, dimensions and complete specifications and markings on it. Equipment of the game with their length, width, weight, thickness, material and dimensions. Protective equipment of the goalkeeper and players.
- Duties of the officials, requirements of the game, equipment needed, numbers of players, reserve bench, running substitution duty of coach, captain, assistant referees, ball boys, doctor, grounds men.
- Laws governing the game. Suspensions, penalizations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches.
- Basic skills and techniques (Passing - types of pass, ground lofted, chip, volley, angle of pass, push, scoop, flick, aerial ball. Receiving the ball - control, dribbling (running with the ball, rhythm and pace, feints, body swerves, screening, beating an opponent from the right to the left, right and behind. Shooting skills with Stick, inside or outside, short and long range shots,

swerving shots, volleys, penalty, power and accuracy. Tackling skills - interception, jockeying for position. Goalkeeping skills - stopping, watching, guiding the team, saving goal, kicking, diving, anticipation, speed, reflexes.

- Principles of play-attack, depth, defence, penetration, team formations 1-2-3-5/1-1-3-4-2/1-1-3-3.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **BASKETBALL**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game.
- Knowledge of the dimensions of the court, thickness of the lines, diagrams and dimensions of the court, full specifications of the ring, pole, boards and ball.
- Duties of the officials, table officials, referees, scorers, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, captain, technical equipment team and player foul markers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments.
- Basic skills and techniques, tactics and team skills Knowledge of basic skills, free throws stance (passing, dribble, shoot); Shooting (jump shot, layup, hook shot); passing (pass, signal, receive feint footwork, chest-pass, bounce pass, overhead pass, javelin pass. Footwork (pivot, 1 count and 2 count stop). One to one defence, fake and drive, pass and cut defence, types of defence, zone defence, and fast break.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **VOLLEYBALL**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game.
- Knowledge of the dimensions and diagram of the court, thickness of the lines, dimensions within the court, full specifications of the net, pole and other equipment required for the game.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, captain, etc.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, default by teams.
- Basic skills and techniques, tactics and team skills, Knowledge of basic skills, volley-two hand pass over the head forearm pass. The serve-underarm, over arm float, over arm jump, over arm top spin, round house jump. The smash - high set cross court, down the line, speed smash, tip the ball over the block. The block-line of defence, defence against smash, attack at set ball. Teamwork importance in both defence and attack. Understanding rotation, blocking and screening
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **BADMINTON**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie, shuttle in play and out of play, importance of lines on the court, singles and doubles.
- Knowledge of the dimensions and diagram of the court, thickness of the lines. Equipment required for the game with their length, width weight, thickness, material and dimensions.

- Duties of the officials, requirements of the game, equipment needed, number of players, duty of coach, match organisers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches, match points, etc.
- Basic skills and techniques - forehand or backhand, correct grip, smash, drop, drive, net play, return upshots and low/high/flick serves. Basic positioning for men and women rallies.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **TENNIS**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, deuce, advantage, tie foot fault. Ball in play and out of play. Dimensions and importance of lines on the court, singles and doubles.
- Knowledge of the dimensions and diagram of the court net, racket, thickness of the lines. Equipment required for the game with their length, width, weight, thickness, material and dimensions. Types of courts.
- Duties and number of officials, requirements of the game, number of players, duty of coach, match organisers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches, match points, etc.
- Basic skills and techniques - forehand or backhand, chopper grip, correct grip, smash, drop, drive, net play, return upshots and low/high/flick serves. Basic positioning for men and women rallies. The racket grip-shake hand. Strokes - backhand push, forehand drive, forward push. Service - two bounce serve, high toss, forehand spin, backhand spin, long serve. Spin - forehand topspin, backhand topspin chopping

blocking lobbing, follow through, placement of ball for each service.

- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **SWIMMING**

- Knowledge of competitive swimming events, activities, strategies and tactics, and how to improve performance (individual and team).
- Detailed understanding of the rules and regulations of various swimming events, strategies and tactics in chosen events. Planning performing and evaluating particular event.
- Knowledge of the dimension, depth and distance of the pool. Importance of starters and judges for start and finish of individual and medley races. Various officials in charge of conducting the events. Types of races, types of strokes, diving competitions, false start, individual and medley events. Stances for different strokes.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, physiotherapist, wind gauge operator, lifeguard, photo finish.
- Laws governing the game. Suspensions, penalisations, draws, fixtures, arrangements needed to conduct tournaments.
- Basic skills and techniques requiring control, balance, weight transfer, flow and clear body positions, complex sequence of movements and ability to perform showing high standards of precision control power speed and stamina, fitness and tactics to outwit the opponents. Warming up and cooling down safely, safety requirements for swimmers.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **ATHLETICS**

- Knowledge of track and field events, activities, strategies and tactics, and how to improve performance (individual and team).

- Detailed understanding of the rules and regulation of various events, strategies and tactics in chosen events. Planning performing and evaluating particular event.
- Knowledge of the dimension of the track. Width of the track. Measurement of 400 and 200 meters, relay and solo races. Equipment of athletes in various events dimensions and requirements. Importance of starters and judges for start and finish. Importance of staggers.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, physiotherapist, wind gauge operator, photo finish.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct meets. Rules and distances and requirements of various events.
- Basic skills and techniques requiring control, balance, weight transfer, flow and clear body positions, complex sequence of movements and ability to perform showing high standards of precision control power speed and stamina, fitness and tactics to outwit the opponents. Warming up and cooling down exercises.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

## CLASS XII

There will be **two** papers in the subject:

**Paper I:** Theory: 3 hours -----70 marks

**Paper II:** Practical Work ----- 30 marks

### PAPER I (THEORY) – 70 Marks

The theory paper will be divided into two Sections A and B. Candidates will be required to answer **five** questions out of **seven** from **Section A**, each carrying **8 marks**. **Section B** will be based on questions on major games in the syllabus. Candidates will be required to select **two** games from this section and answer any **three** of the **five** subparts (a), (b), (c), (d) and (e) from **each** of the **two** selected games of their choice. Each question shall carry **15 marks**.

### SECTION A

#### 1. Sociological Aspects of Physical Education

- (i) Games and sports as man's cultural heritage.

*An understanding that sports have been a part of our culture and tradition since time immemorial.*

- (ii) Development of the individual through games and sports.

*Understanding how games and sports contribute in various ways towards the development of an individual.*

- (iii) Role of Physical Education in promoting national integration.

*How Physical Education helps in promoting National Integration.*

- (iv) Physical Education and personality development.

*The role of Physical education in development of personal qualities like an individual attitude, discipline, helpfulness, team spirit, patience, unity, friendship, etc.*

#### 2. Training Methods

- (a) Meaning and importance of Sports Training.

*Definition of Sports Training and its importance.*

- (b) Methods of training.

*Methods of Training: Repetition, continuous & fartlek, and interval - Definition, purpose, advantages and procedure of each.*

- (c) Warming up, conditioning and cooling/limbering exercises.

– *Meaning of the terms 'warming up', 'conditioning' and 'cooling/limbering'.*

– *Basic exercises related to warming up, conditioning and cooling/limbering.*

– *Advantages of warming up, conditioning and cooling/limbering.*

- (d) Isometric and Isotonic exercises.

*Meaning, advantages and examples of each.*

- (e) Circuit Training.

*Meaning and advantages of circuit training; procedure of conducting circuit training.*

- (f) Weight Training.

*Meaning and advantages of weight training.*

*An understanding of how the above training methods help an individual in different sports and help develop strength, speed, stamina, skill, endurance.*

#### 3. Career Aspects in Physical Education

- (i) Career options in Physical Education.

*Professional sportsmen, sports manager, teacher/lecturer, sports coach, gym instructor, sports officials, sports events coordinators, sports journalist and commentator, sports software engineer, marketing and manufacturing of sports equipment.*

- (ii) Important institutions of Physical Education in India.

*Functions and objectives of Netaji Subhash National Institute of Sports (N.S.N.I.S.), Sports Authority of India (S.A.I), International Olympic Committee (I.O.C), Indian Olympic Association (IOA), YMCA College of Physical Education (Chennai), Lucknow Christian College of Physical Education (LCCPE), Luxmibai National University of Physical Education (LNUPE).*

*Development of training facilities, coaching systems, influence of media and sponsors, campaigns like Health runs in creating awareness towards social evil causes and promoting physical fitness.*

#### 4. Competitions and Tournaments

- (i) Tournaments and types of tournaments.  
*Candidates should be fully aware of:*
- the definition of ‘tournament’.
  - the types of tournaments: Fixtures, Knock-out, league matches (seeding and byes).
  - merits and demerits of tournaments.
  - objectives and importance of intramural and extramural competitions.
  - Names of the National and International Federations/Bodies controlling the various tournaments/competitions.

- (iii) Difference between Professional and Amateur Players.

*Self-explanatory.*

**Note: Candidates should be aware of the above, for the past five years, with respect to the games included in the syllabus.**

#### 5. Health Education & Health Problems

- (a) Meaning and definition of ‘Health’ and ‘Health Education’.

*Meaning and definition of ‘Health’ (mental health and physical health) and ‘Health Education’.*

- (b) Principles and importance of Health Education. Health problems and role of Health Education in solving them.

*Principles and objectives of Health Education. Importance of Health Education for adults and the younger generation through formal and non-formal channels of education. Various prevalent Health Problems: Communicable diseases – meaning, examples and common mode of spread. Epidemics – meaning and examples; Water, noise and air pollution – causes and prevention; Occupational Health Hazards – meaning and examples.*

**Note: Details of specific diseases not required.**

- (c) Disability and Rehabilitation.

*Causes of disability. General principles for prevention of disability;*

*Meaning and scope of Rehabilitation; services available for rehabilitation; role of the community and government organizations in rehabilitation programmes.*

- (d) Posture.

*Meaning of posture.*

*Correct posture – meaning, importance of correct posture (standing, sitting, walking).*

*Common postural deformities: kyphosis, scoliosis, lordosis, flat foot, knock-knees, bowlegged, hunch back, round shoulders – meaning, causes and corrective measures for each.*

- (e) Personal hygiene and sleep requirements.

*Personal hygiene: Meaning of personal hygiene, importance of personal hygiene for a healthy life style. Care of eyes, ears, feet, hair, skin, oral hygiene, nose and clothing.*

*Foot care: causes of corns, broken nails due to tight footwear; Causes of diseases like ring worm, athlete's foot due to walking in wet areas; proper care of feet.*

*Sleep requirements: Sleep requirements for different age groups. Effects of insufficient sleep on human body.*

- (f) Substance Abuse.

*Effects of use of alcohol and smoking on the individual and society.*

*Drugs: Meaning of ‘drugs’ and ‘drug abuse’; Stimulants and Narcotics – Analgesics.*

*Awareness of the fact that use of certain drugs has been banned by World Anti-Doping Agency (WADA) and National Anti-Doping Agency (NADA) and reasons for the same.*

#### 6. Sports Injuries and First Aid

- (i) Sports related injuries.

*Types of sports related injuries: soft tissue injuries (contusion, abrasion, strain and sprain) bone injuries (fracture) and joint injuries (dislocation): causes and prevention of each.*

- (ii) Role of a sportsperson in prevention of sports related accidents.

*Types of injuries due to: sudden movement; environment (hot, cold, wet and dry); lack of preparation (warm up, cool down);*



*inadequate clothing, body protection; not following instructions; surface and facilities, equipment being unsafe. Role of individual in prevention of sports related accidents.*

(iii) First Aid.

*Meaning and importance of 'First Aid'. First Aid for various sports related injuries.*

*First Aid for cuts, grazes, strains, sprains, cramps, blisters, bruises, injuries of bone (fracture and dislocation); application of splints and Thomas splint; First Aid in drowning; Cardio Pulmonary Resuscitation (CPR) and Rest, Ice, Compression and Elevation (RICE).*

## SECTION B

Any **two** of the following games are to be studied:

Cricket, Football, Hockey, Basketball, Volleyball, Badminton, Tennis, Swimming, Athletics.

The following aspects should be studied for **each** of the **two games** selected by the candidate.

Rules and regulations of the game; Interpretation of laws of the game; Duties and responsibilities of the officials and players; Measurement and dimensions related to the game; Terminologies related to the game; Fundamental skills of the game; Strategies and formation of the game; Names and abbreviations of the National and Major International Tournaments linked with the game; Diagrams and dimensions of play area; Diagrams and dimensions of equipment related to the game.

The details for each game are given below:

### CRICKET

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Diagrams of the field and pitch, and various fielding positions.
- Knowledge of the dimensions of the field, thickness of the lines, dimensions of pitch and complete specifications and markings on it. Equipment of the game with their length, width, weight, thickness and material. Score board, scorer and sight screen. Flood light.
- Duties of the officials, before, during and after the match. Umpires and third umpire,

requirements of the game, equipment needed, numbers of players, duty of coach, captain etc.

- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, forfeitures, follow on, tie, power play, match fixing, duck worth rule, sledging, ball tampering.
- Basic skills and techniques. Batting (different types of shots, footwork, body position and actual bat movement. Bowling (run up, delivery stride, follow through, types of bowling variations, good line and length, grip action. Fielding positions, catching and throwing skills, Wicket keeping techniques, skills of getting the batsmen out.
- Different types of signals, extra runs, extra players, runner, substitute, provisions and restrictions, players equipment, danger area, various terms of cricket.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### FOOTBALL

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie breaker, sudden death, ball in play and out of play, importance of lines on the field. Various methods of starting and restarting the game. Substitution procedure, penalty cards and their importance.
- Knowledge of the dimensions of the field, thickness of the lines, dimensions of center circle, quarter circle, goal and penalty area, penalty arc and complete specifications and markings on it. Equipment of the game with their length, width, weight, thickness, material and dimensions. Diagram of goal post and field.
- Duties of the officials, requirements of the game, equipment needed, numbers of players, duty of coach, captain, assistant referees, technical officials, grounds men, ball boys, match organizers, technical area.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures,

arrangements needed to conduct tournaments, punishment on players, coaches.

- Basic skills and techniques (Passing - types of pass, ground lofted, chip, volley, angle of pass. Control (use of various surfaces-head chest, foot thigh). Dribbling (running with the ball, rhythm and pace, feints, body swerves, screening, beating an opponent. Heading the ball with intention of (attacking, defending, jumping, to head down, high, pass, score.) Shooting skills with either foot, inside or outside, short and long range shots, swerving shots, volleys, penalty kicks, power and accuracy. Tackling skills - interception, jockeying for the ball, trapping by various body parts, position, tackle front, side, slide, recovery. Goalkeeping skills - stopping, watching, guiding the team, saving goal, dealing, catching, heading, kicking, punching, throwing, diving, anticipation, speed and reflexes.
- Principles of play-attack, depth, defence, penetration, sweeper systems, 4-4-2, 4-3-3, 4-2-4. Kick-off, corner kick, throw-in, goal kick, free kick, penalty kick. Importance of penalty arc, center circle and lines on the field.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **HOCKEY**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie breaker, sudden death, ball in play and out of play, penalty stroke, short corner, long corner, free hits, hit or push back, 16 yard hit, importance of lines on the field. Start and restart of the match.
- Knowledge of the dimensions and diagrams of the field and goalpost, thickness of the lines, dimensions and complete specifications and markings on it. Equipment of the game with their length, width, weight, thickness, material and dimensions. Protective equipment of the goalkeeper and players.
- Duties of the officials, requirements of the game, equipment needed, numbers of players, reserve bench, running substitution duty of coach,

captain, assistant referees, ball boys, doctor, grounds men.

- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches.
- Basic skills and techniques (Passing - types of pass, ground lofted, chip, volley, angle of pass, push, scoop, flick, aerial ball. Receiving the ball – control, dribbling (running with the ball, rhythm and pace, feints, body swerves, screening, beating an opponent from the right to the left, right and behind. Shooting skills with Stick, inside or outside, short and long range shots, swerving shots, volleys, penalty, power and accuracy. Tackling skills - interception, jockeying for position. Goalkeeping skills - stopping, watching, guiding the team, saving goal, kicking, diving, anticipation, speed. Reflexes.
- Principles of play-attack, depth, defence, penetration, team formations 1-2-3-5/1-1-3-4-2/1-1-3-3.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **BASKETBALL**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game.
- Knowledge of the dimensions of the court, thickness of the lines, diagrams and dimensions of the court, full specifications of the ring, pole, boards and ball.
- Duties of the officials, table officials, referees, scorers, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, captain .technical equipment team and player foul markers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments.
- Basic skills and techniques, tactics and team skills Knowledge of basic skills, free throws stance (passing, dribble, shoot). Shooting (jump

shot, layup, hook shot), passing (pass, signal, receive feint footwork, chest-pass, bounce pass, overhead pass, javelin pass. Footwork (pivot, 1 count and 2 count stop) One to one defence, fake and drive, pass and cut Defence, types of defence, zone defence, and fast break.

- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **VOLLEYBALL**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game.
- Knowledge of the dimensions and diagram of the court, thickness of the lines, dimensions within the court, full specifications of the net, pole and other equipment required for the game.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, captain, etc.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, default by teams.
- Basic skills and techniques, tactics and team skills Knowledge of basic skills, volley-two hand pass over the head forearm pass. The serve-underarm, over arm float, over arm jump, over arm top spin, round house jump. The smash - high set cross court, down the line, speed smash, tip the ball over the block. The block-line of defence, defence against smash, attack at set ball. Teamwork importance in both defence and attack. Understanding rotation, blocking and screening
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **BADMINTON**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, extra time, tie, shuttle in play and out of play, importance of lines on the court, singles and doubles.
- Knowledge of the dimensions and diagram of the court, thickness of the lines. Equipment required for the game with their length, width weight, thickness, material and dimensions.
- Duties of the officials, requirements of the game, equipment needed, number of players, duty of coach, match organisers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches, match points, etc.
- Basic skills and techniques - forehand or backhand, correct grip, smash, drop, drive, net play, return upshots and low/high/flick serves. Basic positioning for men and women rallies.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### **TENNIS**

- Knowledge of the game, strategies and tactics, and how to improve performance.
- Detailed understanding of the rules and regulations of the game. Match time, deuce, advantage, tie foot fault. Ball in play and out of play. Dimensions and importance of lines on the court, singles and doubles.
- Knowledge of the dimensions and diagram of the court net, racket, thickness of the lines. Equipment required for the game with their length, width, weight, thickness, material and dimensions. Types of courts.

- Duties and number of officials, requirements of the game, number of players, duty of coach, match organisers.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct tournaments, punishment on players, coaches, match points, etc.
- Basic skills and techniques - forehand or backhand, chopper grip, correct grip, smash, drop, drive, net play, return upshots and low/high/flick serves. Basic positioning for men and women rallies. The racket grip-shake hand. Strokes - backhand push, forehand drive, forward push. Service - two bounce serve, high toss, forehand spin, backhand spin, long serve. Spin - forehand topspin, backhand topspin chopping blocking lobbing, follow through, placement of ball for each service.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### SWIMMING

- Knowledge of competitive swimming events, activities, strategies and tactics, and how to improve performance (individual and team).
- Detailed understanding of the rules and regulations of various swimming events, strategies and tactics in chosen events. Planning performing and evaluating particular event.
- Knowledge of the dimension, depth and distance of the pool. Importance of starters and judges for start and finish of individual and medley races. Various officials in charge of conducting the events. Types of races, types of strokes, diving competitions, false start, individual and medley events. Stances for different strokes.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, physiotherapist, wind gauge operator, lifeguard, photo finish.
- Laws governing the game. Suspensions, penalisations, draws, fixtures, arrangements needed to conduct tournaments.

- Basic skills and techniques requiring control, balance, weight transfer, flow and clear body positions, complex sequence of movements and ability to perform showing high standards of precision control power speed and stamina, fitness and tactics to outwit the opponents. Warming up and cooling down safely, safety requirements for swimmers.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

### ATHLETICS

- Knowledge of track and field events, activities, strategies and tactics, and how to improve performance (individual and team).
- Detailed understanding of the rules and regulation of various events, strategies and tactics in chosen events. Planning performing and evaluating particular event.
- Knowledge of the dimension of the track. Width of the track. Measurement of 400 and 200 meters, relay and solo races. Equipment of athletes in various events dimensions and requirements. Importance of starters and judges for start and finish. Importance of staggers.
- Duties of the officials, table officials, referees, requirements of the game, equipment needed, numbers of players, reserve bench, duty of coach, physiotherapist, wind gauge operator, photo finish.
- Laws governing the game. Suspensions, penalisations, draws, match fixtures, arrangements needed to conduct meets. Rules and distances and requirements of various events.
- Basic skills and techniques requiring control, balance, weight transfer, flow and clear body positions, complex sequence of movements and ability to perform showing high standards of precision control power speed and stamina, fitness and tactics to outwit the opponents. Warming up and cooling down exercises.
- Knowledge of associations and federations linked to the game. Important tournaments. Abbreviations of associations and federations concerned with the game.

## PRACTICAL WORK - 30 Marks

No question paper for practical work will be set by the Council.

The Practical Work will be evaluated in two parts as follows:

1.	Continuous Evaluation (by the Teacher)	10 marks
2.	Practical Evaluation (by Visiting Examiner)	20 marks

### 1. CONTINUOUS EVALUATION (by the Teacher): 10 Marks

Continuous evaluation will be done by the teacher(s) responsible for preparing the candidate for the examination, in *two of the following games and activities of the candidate's choice*:

Athletics, Cricket, Hockey, Football, Volleyball, Softball, Basketball, Tennis, Badminton, Swimming, Dancing, Gymnastics, Yoga.

**Continuous Evaluation will include the following:**

A.	File Work done throughout the year on any two games/activities.	4 marks
B.	Participation and performance of the candidate, throughout the year, in at least any two games/activities of his/her choice.	3 marks
C.	Physical Efficiency Tests.	3 marks

### 2. PRACTICAL EVALUATION (by the Visiting Examiner): 20 Marks

Practical evaluation will be done by the Visiting Examiner in the presence of the teacher and will consist of the following:

A.	Physical Efficiency Tests	12 marks
B.	Specialisation Tests (The candidate is to be evaluated on <b>any two</b> basic skills of the two games/activities chosen by him/her for Continuous Evaluation)	6 marks
C.	Viva-voce (on the two games/activities chosen by the candidate)	2 marks

## A. PHYSICAL EFFICIENCY TESTS

The following are the tests to evaluate the physical fitness of candidates. *These tests are to be used for Continuous Assessment by the Teacher as well as for Practical Assessment by the Visiting Examiner.* Tests 1 to 3 should be conducted on one day and 4 to 6 on the next.

### (a) Test 1

**50 metre run, standing start:** Timings to be taken to the nearest tenth of a second (weather should be relatively windless without extremes of temperature).

### (b) Test 2

**Standing long jump:** A flat no slip surface should be used. The candidate should stand with toes just behind the take-off line and jump when ready. After making preliminary swing with the arms the candidate swings them forward vigorously, springing with both feet simultaneously to land as far forward as possible. Distance jumped to be measured in centimetres.

### (c) Test 3

**Distance run** - 1000 metres run for boys, 600 metres run for girls. Time to be taken to the nearest second.

### (d) Test 4

(i) **Floor push-ups for boys:** The boy takes a front-leaning position with body supported on hands and balls of feet; the arms are straight and at right angles to the body. He then dips or lowers the body so that the chest touches or nearly touches the floor, then pushes back to the starting position by straightening the arms and repeats the procedure as many times as possible. Only the chest should touch the floor; the arms must be completely extended with each push-up; the body must be held straight throughout. Scoring consists of the number of correct push-ups.

(ii) **Push-ups for girls:** This is executed from a stall bar bench or a stool 32 cm high by 50 cm long and 35 cm wide. It should be placed on the floor about 15 cm from a wall so that the subject will not take a

position too far forward. The girl should grasp the outer edges of the bench, or stool, at the nearest corners and assume the front-leaning rest position, with the balls of her feet on the floor and with her body and arms forming a right angle. She should then lower her body so that the upper chest touches the near edge to the bench or stool, then raise it to a straight arm position as many times as possible. The girl's body should be held straight throughout. If the body sways or arches, or if the subject does not go completely down or does not push completely up, half credit is given up to 4 half credits.

(e) **Test 5**

**Shuttle run:** A flat course of 10 metres is required to be measured between the two parallel base lines. Behind each base line, a semicircle 50 cm radius with centre on the base line is required to be marked. In the far semicircle two wooden blocks (5x5x5 cm) are to be placed. The candidate stands with feet behind the base line, and on a signal, runs to the far line, picks up one block which the candidate places in the starting semicircle when he/she returns. The candidate then repeats the procedure with the second block. The time to the nearest tenth of a second is to be taken till the second block is grounded in the starting semicircle.

(f) **Test 6**

**60-second sit-ups:** The candidate lies with his/her back on a mat or flat surface, feet about 30 cm apart and knees flexed at a right angle. The candidate's hands with fingers interlocked are placed behind the back. A partner holds the candidate's feet in contact with the mat or floor. On the signal "Go" the candidate sits up to touch the knees with his/her elbows. Without pause he/she returns to his/her starting position and immediately sits up again. The number of sit-ups completed in 60 seconds are to be counted.

**B. SPECIALISATION TESTS**

Candidates are to be tested by a Visiting Examiner in the presence of the teacher in **two** of the games/activities that were selected by them for Continuous Assessment. Details of skill areas are given below.

**ATHLETICS**

Candidates will choose two of the following events in which they wish to be tested:

- (i) Track events - sprints, middle and long distance races:

**Boys** - 100 m, 200 m, 400 m, 800 m, 1500 m and 3000 m.

**Girls** - 100 m, 200 m, 400 m, 800 m.

- (ii) Track events – hurdles:

**Boys** - 110 m and 400 m.

**Girls** - 100 m.

- (iii) Field events - jumps and throws:

**Boys** - Broad jump, high jump, triple jump, pole vault, shot-put, discus throw, javelin throw, hammer throw.

**Girls** - Broad jump, high jump, shot-put, discus throw.

The following fundamental skills are required:

**Sprints**

Practice of starts with blocks using proper command.

Time action period - Reaction time, block clearance time, acceleration time, velocity maintenance time, finish time.

**Middle Distance and Long Distance Races**

- (i) Style of endurance running.

- (ii) Methods of endurance development.

**Broad Jump**

- (i) Approach run.

- (ii) Take off.

- (iii) Flying Phase.

- (iv) Landing.

### **Hop, Step and Jump (Triple Jump)**

- (i) Approach run.
- (ii) Take off.
- (iii) Performance of hop, step and jump.
- (iv) Performance of combination of hops and steps.

### **High Jump**

- (i) Approach run.
- (ii) Take off.
- (iii) Flying phase: scissors, straddle, western roll or "Fosbury flop".

### **Pole Vault (Boys only)**

- (i) Grip.
- (ii) Pole carry.
- (iii) Approach run.
- (iv) Take off.
- (v) Planting of pole.
- (vi) Clearance of bar.
- (vii) Landing.

### **Javelin Throw**

- (i) Grip.
- (ii) Javelin carry.
- (iii) Transition from approach to five stride rhythm.
- (iv) Release.
- (v) Reverse.

### **Shot put**

- (i) Stance.
- (ii) Glide.
- (iii) Release.
- (iv) Reverse.

### **Discus Throw**

- (i) Stance.
- (ii) Preliminary Swings.
- (iii) Throws with one and a half turn.
- (iv) Reverse.

### **CRICKET**

1. **Batting** : pull, cut, hook, glance, stepping out to drive the flighted ball.
2. **Bowling** : outswing, inswing, off break, leg break and googly.
3. **Fielding** : Catching high and low and ground balls.

### **HOCKEY**

1. **Straight hitting and stopping:**
  - (a) Reverse hitting and stopping
  - (b) Hitting on the wrong foot
2. **Straight push and stopping:**
  - (a) Reverse push and stopping
  - (b) Pushing on the wrong foot
3. **Scooping:**
  - (a) Push scoop
  - (a) Shovelling
4. **Flick:**
  - (a) Straight Flick
  - (b) Reverse flick
  - (c) Flick on the wrong foot
5. **Dribbling and carrying the ball**
6. **Passing:**
  - (a) Through pass
  - (b) Return pass
  - (c) Deflection pass
  - (d) Interchanging position
7. **Dodging:**
  - (a) Dodging to opponent's left.
  - (b) Dodging to opponent's right.
  - (c) Double dodging.
8. **Different Techniques of:**
  - (a) Corner
  - (b) Penalty stroke
  - (c) Push in
  - (d) Goal keeping
9. **Tackling:**
  - (a) Lunging
  - (b) Feinting

## FOOTBALL

### 1. Passing and Interpassing:

- (a) Interpassing between two players.
- (b) Interpassing among three players.
- (c) Three men weave.
- (d) Interpassing among four players.
- (e) Related practices.

### 2. Kicking:

- (a) Revision of all kicking fundamentals.
- (b) Lofted kick with either foot.
- (c) Practice of corner kicks - lobbing chip shots and penalty kicks.

### 3. Tackling:

- (a) Interception and hasty tackles.
- (b) Sliding tackles.
- (c) Related practices.

### 4. Heading:

- (a) Related practices, front, right side and left side.
- (b) Head-up drills.

### 5. Dribbling:

Practice of dribbling skills suited to actual playing situations.

### 6. Tactics and coaching:

- (a) Two back system - three back system.
- (b) Principles of zone and man to man defence.
- (c) Free kicks, penalty kicks, corner kicks.
- (d) Tactics of defence and attachment.

## VOLLEYBALL

### 1. The Pass:

- (a) Over-head pass: Two-handed pass with back rolling.
- (b) Two-handed pass with side rolling.
- (c) Jump and pass.
- (d) Under arm pass.
- (e) Forward dive and pass.
- (f) One arm pass with side rolling.

### 2. The Serve:

- (a) Over head service (Tennis-type).
- (b) Round arm service.
- (c) Floating service (overhead and arm).

### 3. The Set-up:

- (a) Setting up for quick smash.
- (b) Move and set up (from back zones).
- (c) Setting up to different zones at varying trajectories.

### 4. The Net Recovery:

Two-handed overhead pass without rolling, one hand under arm with or without rolling.

### 5. The Attack:

- (a) Smash with turn of body.
- (b) Smash with turn of wrist.
- (c) Round arm smash.
- (d) Smash on short pass (ascending balls).
- (e) Simple attack combination.

### 6. The Block:

- (a) Double block against different types of attack.
- (b) Double block in assigned zones.
- (c) Double block against quick attack.
- (d) Double block against attack combination.
- (e) Triple block against attack from zone.

### 7. Patterns of play:

4-2 system, 5-1 system.

## BASKETBALL

### 1. Ball handling:

Holding position of fingers, body, position, stance of player with ball.

### 2. Catching the ball:

(Receiving) skills involved.



- 3. Passing: Skills - (Drills in Pairs)**
- Two-handed chest pass.
  - Two-handed bounce pass.
  - Two-handed underhand pass (Right / Left side).
  - Two-handed over head pass.
- 4. Dribbling:**  
Dribbling high with speed, using alternate hands, low dribble.
- 5. Shooting:**
- Two-handed set shot.
  - Two-handed free throw.
  - Lay up shot following dribble using right hand (over the shoulder layup).
- 6. Footwork:**  
Player stance, position of feet, position of hand, elementary shuffling and slicing movements (drills).
- 7. Pivoting, Stationary Pivot.**
- 8. Individual defence:**  
Player stance: position of hands, position of feet, defender's position in between opponent and basket.
- 9. Team defence:** Man to man defence.
- 10. Team offence:** First break offence.
- 11. Full Court:** Half court game using defence, offence taught.

### SOFTBALL/TENNIS/BADMINTON

Candidates will be required to demonstrate competency in the rules, skills and fitness training related to the game.

### SWIMMING

Candidates will be tested in *two* of the following events of their choice.

**Boys:** Free style – 50m, 100 m, 200 m, 400 m, 800 m.

Breast stroke – 50m, 100 m and 200 m.

Back stroke - 50m and 100m

Butterfly stroke - 50 m and 100 m

Diving - Forward dive, backward dive, reverse dive and inward dive.

**Girls:** Free style – 50m, 100 m, 200 m.

Breast stroke - 50 m and 100 m.

Back stroke - 50 m and 100 m

Butterfly stroke - 50 m and 100 m.

Diving - Forward dive, backward dive, reverse dive and inward dive.

### DANCING

The candidates will be required to give a performance of any *two* of the following dances of their choice, with suitable accompaniment:

- Indian dancing:* Bharatanatyam, Kuchipudi, Kathakali, Kathak, Manipuri, Odissi, Mohiniyattam, Bhangra and other folk dances.
- Western dancing:* Ballet, ballroom dancing, waltz, fox trot, tango, samba, charleston, square dancing; pop-dancing - jitterbug, twist, rock-and-roll.

### GYMNASTICS

The candidates will be tested in four exercises using any two of the following bits of apparatus of their choice.

#### (i) Floor Exercise

Boys - handspring to front somersault (tucked); two headsprings; cartwheel to arabesque; arab spring; side somersault; back roll to handstand, cabriole jump throw; flic-flacs.

Girls - Leap and cabriole; step into ball of either foot; flic-flacs; round off; handspring; cat leap; legs split in air, cartwheel; handstand.

#### (ii) Balancing Beam (Girls only)

Run 2-3 steps; leap to riding seat with  $\frac{1}{2}$  turn; rise to squat stand; ballet stand with  $\frac{1}{2}$  turn; leap on either foot; step forward leap changing legs to rear leap; lunge to side; stag leap; one-arm cartwheel.

**(iii) Parallel bars** (Boys only)

Swing forward and cast to upper arm hand; forward roll; pirouette forward; lower to upper arm hand; swing backward; straddle forward to support (hold).

**(iv) Vaulting horse**

Boys - (long horse) Split vault; through vault; hand stand with cartwheel; cartwheel and handspring.

Girls - Astride vault; split vault, through vault; handspring.

**(v) Horizontal bar** (Boys only)

Forward and backward giant swings; change of grip; twists; the hip-circles.

## YOGA

Candidates will be tested in any *four* of the following asanas:

- (i) Vrikshasana (Balancing on one leg with the other flexed sideways).
- (ii) Utitha Trikonasana (Feet apart stand, side bending).
- (iii) Parivrtta Trikonasana (Feet apart stand, side bend, with the trunk rotated backward).
- (iv) Utitha Parvakonasana (Feet apart stand lunging on one side).
- (v) Purivrita Parvakonasana (Feet apart stand lunging on one side and rotate the trunk backwards).
- (vi) Virabhadrasana (Balancing on one leg with stretched hands, trunk and leg in a horizontal position).
- (vii) Uthitha Hasta Padangusthasana (Balancing on one leg and trunk bending over the other stretched horizontally).
- (viii) Parasuottansan (Feet apart stand and turning one side and bend the trunk over the knee on that side).
- (ix) Ushtrarsan (kneel sit and flex back the trunk).
- (x) Padakastasan (Attention position, flex and trunk over the thighs).
- (xi) Garudasan (Balancing one leg with the other turned over the former).

(xii) Navasana (Balancing on buttocks with the legs and trunk flexed over each other).

(xiii) Vajrasana (Sitting with flexed legs feet on the side of buttocks).

(xiv) Supta Vajrasana (Supine lying in the position of Vajrasana).

(xv) Kukutasana (Balancing on hands inserted through the thighs and legs in padmasana).

(xvi) Jannasirana (Paschimattrawasana on one leg with the other leg flexed sideways).

(xvii) Ardha Baddha Padma Paschimttanasana (Paschimattanasana on one leg with the other in Padmasana position).

(xviii) Triang Mahaikapada Paschimattanasana (Paschimottanasana on one leg with the other in Najrasana position).

(xix) Moridriasana (Long sit with one knee flexed and kept up and trunk turned over the stretched leg).

(xx) Akanrava Dhanrasana (Long sit and pull one foot to the corresponding ear).

(xxi) Uparrshta Konasana (Long sit with feet spread and bring the head to the ground).

(xxii) Bakasana (Balancing on hands with thighs over the arms above elbows).

(xxiii) Chakrasana (Cartwheel position).

(xxiv) Nowli (contracting rectii abdominal in uddiyana position alternate relaxation and contraction of left and right muscles in quick succession).

(xxv) Kapalabathi (Quick succession of abdominal strokes in padmasana position).

(xxvi) Bhastrika (Pranavam following the strokes of Kapalabathi).

### **NOTE:**

While testing the candidates in any two games/activities of their choice, the following method should be adopted. Test of the skill as a whole with emphasis on:

- (i) Approach
- (ii) Stance/Grip
- (iii) Execution (degree of perfection) and
- (iv) Follow through.

**PERFORMANCE TABLE - PHYSICAL EDUCATION**

**PHYSICAL EFFICIENCY TESTS**

Marks	Test No. 1 50m dash (Timing in seconds and tenths)		Test No. 2 Standing long jump (Distance in cm)		Test No. 3 Distance run (Timing in minutes and seconds)		Test No. 4 Push-ups (Numbers)		Test No. 5 Shuttle run (Timing in seconds and tenths)		Test No. 6 60 s sit-ups (Numbers)	
	Boys	Girls	Boys	Girls	Boys (1000m)	Girls (600m)	Boys	Girls	Boys	Girls	Boys	Girls
5	6.5	7.6	204	167	4 min 10 s	2 min 30 s	30	22	9.8	11.0	47	30
4	6.6	7.9	197	155	4 min 20 s	2 min 40 s	24	14	10.0	11.2	44	28
3	6.8	8.2	190	149	4 min 30s	2 min 50 s	17	8	10.2	11.6	41	26
2	7.1	8.4	183	142	4 min 40 s	3 min	10	6	10.6	11.9	37	24
1	7.5	8.9	175	132	4 min 50 s	3 min 10 s	6	3	11.1	12.1	32	20

**PERFORMANCE TABLE - PHYSICAL EDUCATION SPECIALISATION TESTS**

**ATHLETICS - FIELD EVENTS**

Marks	Long jump (m and cm)		High jump (m and cm)		Hop step & jump (m and cm)	Pole vault (m and cm)	Shot put throw (m and cm)		Discus (m and cm)	Javelin throw (m and cm)
	Boys	Girls	Boys	Girls	Boys	Boys	Boys	Girls	Boys	Boys
10	5.50	5.00	1.70	1.50	12.00	3.00	10.00	8.50	25.00	35.00
8	5.00	4.50	1.55	1.45	11.50	2.75	9.00	7.50	22.00	32.00
6	4.50	4.00	1.40	1.30	11.00	2.25	8.00	6.50	19.00	29.00
4	4.00	3.50	1.30	1.20	10.50	2.00	7.00	5.50	16.00	26.00
3	3.50	3.00	1.20	1.10	10.00	1.75	6.00	4.50	13.00	23.00
2	3.00	2.50	1.10	0.95	9.50	1.50	5.00	3.50	10.00	20.00
1	2.99	2.00	1.00	0.94	9.49	1.25	4.99	3.49	9.98	19.98

**PERFORMANCE TABLE - PHYSICAL EDUCATION SPECIALISATION TESTS**

**ATHLETICS - TRACK EVENTS**

Marks	100 m (s and tenths)		200 m (s and tenths)		400 m (s and tenths)		800 m (s and tenths)		1500 m (min and s)
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
10	11.5	13.6	24.0	25.0	56.0	68.0	2.10	2.45	4.40
8	11.8	14.4	25.1	26.1	56.1	68.1	2.15	2.50	4.45
6	12.4	15.2	26.1	27.1	58.1	71.1	2.20	2.55	4.50
4	13.2	16.0	27.1	30.1	60.1	74.1	2.30	3.05	5.00
3	14.0	16.8	28.1	33.1	62.1	77.1	2.40	3.15	5.10
2	14.8	17.6	29.1	36.1	64.1	80.1	2.50	3.25	5.20
1	15.6	18.5	30.1	39.1	66.1	83.1	3.00	3.35	5.30

**PERFORMANCE TABLE - PHYSICAL EDUCATION SPECIALISATION TESTS**

**SWIMMING**

Marks	50m free style (s and tenths)		100m free style (min and s)		200m free style (min and s)		400m free style (min and s)	50m breast-stroke (min and s)		100m breast-stroke (min and s)
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Boys	Girls	Boys
10	45.0	55.0	1:30	1:50	3.00	3.40	6.00	1.05	1.20	2:15
9	46.3	56.3	1:32.5	1:53	3.05	3.46	6.10	1.07	1.22.5	2:17.5
8	47.5	57.5	1:35	1:55	3.10	3.50	6.20	1.10	1.25	2:20
7	50.0	60.0	1:40	2:00	3.20	4.00	6.40	1.12	1.27.5	2:25
6	52.5	62.5	1:45	2:05	3.30	4.10	7.00	1.15	1.30	2:30
5	55.0	65.0	1:50	2:10	3.40	4.20	7.20	1.17	1.32.5	2:35
4	57.5	67.5	1:55	2:15	3.50	4.30	7.40	1.20	1.35	2:40
3	58.7	68.7	1:57.5	2:17.5	3.55	4.35	7.50	1.22	1.37	2:42.5
2	60.0	70.0	2:00	2:20	4.00	4.40	8.00	1.24	1.39	2:45
1	61.2	71.2	2:02.5	2:22.5	4.00.5	4.45	8.10	1.26	1.41	2:47

**Note:** For timings in between or higher than those indicated in the table the lower mark should be given.

**PERFORMANCE TABLE - PHYSICAL EDUCATION SPECIALISATION TESTS**

**SWIMMING (*continued*)**

Marks	50m back stroke (min and s)		100m back stroke (min and s)	50m butterfly stroke (min and s)		100m butterfly stroke (min and s)	Diving
	Boys	Girls	Boys	Boys	Girls	Boys	Description of action
10	0:55	1:10	2:00	0:55	1:05	1:50	Vertical, erect body, arms and legs together  Poor angle (either backward or forward)  Poor angle opening of arms in front, side, etc.  Poor angle opening of arms and legs  Poor angle opening of arms and legs in flight.
9	1:00	1:15	2:00.5	0:57	1:10	1:52.5	
8	1:02.5	1:17.5	2:05	1:00	1:12.5	1:55	
7	1:05	1:20	2:10	1:02.5	1:15	2:00	
6	1:07.5	1:22.5	2:15	1:05	1:17.5	2:05	
5	1:10	1:25	2:20	1:07.5	1:20	2:10	
4	1:12.5	1:27.5	2:25	1:10	1:22.5	2:15	
3	1:14	1:29	2:27.5	1:12.5	1:24	2:17.5	
2	1:15	1:30.5	2:30	1:14	1:25	2:20	
1	1:16	1:31	2:32.5	1:16	1:26	2:25	

**Note:** For timings in between or higher than those indicated in the table the lower mark should be given.

## SAMPLE TABLE FOR PRACTICAL WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	CONTINUOUS ASSESSMENT (TO BE DONE BY THE TEACHER)			PRACTICAL ASSESSMENT (TO BE DONE BY THE VISITING EXAMINER ONLY)			TOTAL MARKS Continuous Assessment + Practical Assessment (To be entered by the Visiting Examiner)
		File Work done throughout the year	Participation & performance of candidates in two games of their choice	Physical Efficiency Tests	Physical Efficiency Tests	Specialisation Tests	Viva (on any 2 games/ activities chosen)	
		<b>4 Marks</b>	<b>3 Marks</b>	<b>3 Marks</b>	<b>12 Marks</b>	<b>6 Marks</b>	<b>2 Marks</b>	<b>30 Marks</b>
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Name of the Teacher: \_\_\_\_\_

Name of the Visiting Examiner: \_\_\_\_\_

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Date: \_\_\_\_\_

# ENVIRONMENTAL SCIENCE (877)

## Aims:

1. To help the student appreciate man's place in the natural systems.
2. To provide a wide understanding of knowledge resources relevant to environment protection and conservation.
3. To provide an in-depth study of certain environment related areas.
4. To place environmental concerns in a technological, social, political and economic context.
5. To provide a context for understanding the role of individual values in conservation.
6. To provide a context for the individual student to reflect on his/her beliefs and values in relation to the environment.
7. To provide an opportunity to acquire interdisciplinary skills, knowledge and understanding and to apply this logically and coherently in the field of environmental conservation.
8. To encourage student initiative and resourcefulness in action leading to environmental protection and conservation.
9. To present environmental concerns in a challenging way and thereby encourage students to consider careers in the environmental field.

## CLASS XI

There will be **two** papers in the subject:

**Paper I:** Theory - 3 hours ... 70 marks

**Paper II:** Practical/ Project Work - ... 30 marks

### PAPER I - THEORY

There will be one written paper of three hours duration carrying 70 marks divided into two parts.

**Part 1 (20 marks)** will consist of **compulsory** short answer questions from the entire syllabus.

**Part 2 (50 marks)** will be divided into three sections. Each section will consist of **three** questions. Candidates will be expected to answer **five** questions choosing at least **one** from each section.

### SECTION A

#### 1. Modes of Existence

- (i) Modes of existence and resource use: hunting - gathering; pastoral; agricultural; industrial.

*Modes of existence and resource use: hunting - gathering; pastoral; agricultural; industrial. Two features defining each mode of existence.*

- (ii) Their impact on natural resource base: energy resources; material resources; scale of catchment; quantity of resources used.

*Impact of each mode on the available natural resources.*

- (iii) Their ecological impact: land transformation; habitat; diversity; modification of biogeochemical cycles; modification of climate; substantial use.

*The scale of catchment; quantity of resources used, land transformation; impact on habitat, biodiversity, modification of biogeochemical cycles, modification of climate, substantial use to be taught only to create a better understanding and **not for testing***

- (iv) Their social organisation: size of group; kinship; division of labour; access to resources.

*Self-explanatory.*

- (v) Their ideology and idiom of man-nature relationship.

*Self-explanatory.*

- (vi) An appreciation of the coexistence of all four modes of existence in contemporary India.

*Self-explanatory.*

- (vii) Ecological conflicts arising therein.

*Self-explanatory.*



## 2. Ecology

- (i) Concept of an ecosystem: definition; relationships between living organism, e.g. competition, predation, pollination, dispersal, food chains, webs; the environment - physical (soil, topography, climate); biotic - types of relationships (competition, mutualism, parasitism, predation, defence); soil types and vegetation; co-evolution and introduction of species.

*Definition of ecology and ecosystem. Structure of an ecosystem: biotic and abiotic components.*

*Trophic relationships: food chains and food webs. Biomagnification and bioaccumulation of toxic wastes.*

*Relationships between living organisms: competition, predation, mutualism, parasitism, commensalism. Examples of each type.*

*Coevolution - Definition and types with examples.*

- (ii) Habitats and niches: Gause's competitive exclusion principle; resource partitioning.

*Definition and a basic understanding of the above.*

- (iii) Flow of energy: efficiencies - photosynthetic - trophic - assimilation - production; trophic levels; generalised model of the ecosystem; ecological pyramid (numbers and biomass); food webs.

*An understanding that a small fraction of the sun's energy is captured by the primary producers and thereafter, at every trophic level, assimilation efficiency reduces. Pyramid of flow of energy.*

- (iv) Nutrient cycles: generalised model; a study of carbon, nitrogen cycles (biological and geological); man's intervention; pollution as disruption of these cycles; ecosystem as a source of material and sink waste for human societies; ecological succession - causes (autogenic and allogenic) - patterns of successions.

*An understanding of hydrological, carbon, nitrogen and phosphorous cycles showing the linkages between the biotic and abiotic elements (An understanding that different*

*species thrive under different conditions – a basic understanding of the Law of Tolerance).*

*Definition of Ecological succession. Classification as primary and secondary. Causes (autogenic and allogenic). Understanding of the stages of succession.*

- (v) Biomes: terrestrial; fresh water; marine; a survey of the biomes of India and their inhabitants.

*Examples of Biomes - Tropical rain forests, deserts, grasslands, coral reefs, lakes. Any five biomes to be explained with reference to climate, topography, flora, fauna and their adaptations.*

## 3. Pollution

- (i) Disruption of nutrient cycles and habitats: atmospheric pollution; human activities that change the composition of the atmosphere; connection between pollution and development; local and global effects (greenhouse effect, ozone depletion) and their impact on human life; burning of fossil fuel products - effect on ecosystem and human health.

• *Air pollution: definition and causes.*

• *Human activities that disrupt hydrological, carbon, phosphorus and nitrogen cycles. The effects of these disruptions. An understanding of how developmental activities lead to air pollution. A few examples at local and global level.*

• *An understanding of greenhouse effect. Human sources of greenhouse gases. Explanation of the local and global effects of:*

– *burning fossil fuel products (any two)*

– *global warming with particular reference to the ecosystem, human health, sea level, biodiversity and forests.*

- (ii) Pollution control approaches - prevention and control: as applied to fossil fuel burning; the role of PCBs; industrial pollution control - principles - devices - costs - policy

incentives; combating global warming; the international political dimensions; third world interest; impact on economic growth.

- *Need for pollution control. Pollution prevention and control measures – Role of Pollution Control Boards; one example of a PCB in a metropolitan city.*
- *Approach: correction at source (prevention), pollution cleanup – study of any two common devices. [As applied to fossil fuel burning]*
- *Industrial pollution: removal of particulate pollutants (cyclone collector, electrostatic precipitator) – removal of gaseous pollutants by wet dry system.*
- *Indoor pollution: Common pollutants, sources and effect.*
- *Subsidies and incentives for green automobiles, green architecture, green energy and green technology in the Indian context.*
- *Problems related to combating global warming – lack of international cooperation, long term issue, effect not uniform, impact on lifestyle and economy as a reason for resistance.*
- *International political dimensions – developing countries not prepared to take steps at the cost of development, demand for cheap green technology to reduce emissions.*

(iii) Water pollution: water cycle; pollution of surface water, ground water, ocean water; industrial pollution and its effects; domestic sewage and its treatment - techniques and appropriate technology; marine ecosystem protection and coastal zone management; soil pollution - sources - effects.

- *Definition of water pollution.*
- *Understanding water cycle.*
- *Causes of pollution of surface, ground and ocean water and their effects. Point and non-point sources of water pollution.*
- *Difficulty in dealing with ground water pollution.*

- *Industrial pollution – heat and radioactive substances and their effects – early hatching of fish eggs, failure to spawn, decrease in species diversity, migration of aquatic forms.*
- *Domestic sewage treatment – primary and secondary treatment and treatment by working with nature.*
- *Protective measures taken for conserving marine ecosystems and coastal zone management.- establishment of protective marine sanctuaries, integrated coastal management, regulated coastal development, ban on dumping waste and sewage in coastal water, ban on dumping sludge in oceans, protection of sensitive areas from oil drilling, double hull for oil tankers.*
- *Soil pollution – sources, effects and mitigation.*

## **SECTION B**

### **4. Legal Regimes for Sustainable Development**

- (i) National legislative frameworks for environment protection and conservation; survey of constitutional provisions (including directive principles); national laws; state laws in India.
  - *Constitutional provisions- the Article 48A and 51 A of Directive Principles of State Policy. 73<sup>rd</sup> and 74<sup>th</sup> constitutional amendment act (Main objectives of the above).*
  - *Legislative framework:*
    1. *Environmental Protection Act 1986.*  
*The Bhopal Gas Tragedy and how it influenced Environmental Legislation in India – The passing of an Umbrella Environmental Legislation - The Environmental Protection Act 1986;*
    2. *Forest (Conservation) Act 1981;*
    3. *Wildlife Protection Act 1972;*
    4. *Biological Diversity Act 2002;*

5. *Water (Prevention and Control of Pollution) Act 1974;*
6. *Air (Prevention and Control of Pollution) Act 1981.*

**Two main objectives of each of the above Acts to be studied.**

- (ii) International legal regimes: on trade and environment (GATT, WTO, IPR, TNC's, regional arrangements and preferential trade arrangements); on climate; on common resources (forests, bio-diversities, oceans and space); international institutions (UNEP, UNCTAD, WHO, UNDP, etc.); international initiatives (Earth Summit, Agenda 21).

*GATT: historical perspective (origin and objectives and transformation into WTO); WTO: Principles and functions (Case study of disputes, examples); IPR : Types: (a) Patents (Products vs Process), (b) Trademark, copyright, geographical indicators and industrial designs; Transnational Corporations (TNC) – definition, impact of TNC on the environment, use of resources, waste disposal, manmade ecological disaster. Case study of EXXON and BP oil spills*

*International institutions (UNEP, UNCTAD, WHO, UNDP, etc.); international initiatives (Earth Summit, Agenda 21) – a brief understanding of their role in environmental protection.*

## 5. Technology and Environment

- (i) Technological evolution and models: hi-tech; low-tech; intermediate; appropriate; traditional; interaction between technology, resources, environment and development; energy as a binding factor; the need for reorienting technology.
- *Definition of technology, a brief overview of the evolution of technology and its impact on human societies.*
  - *Definitions of hi-tech, low-tech. and intermediate technology – their impacts on natural resources.*
  - *Understanding the difference between appropriate and traditional technology.*

- *Industrial revolution - genesis of ongoing technological revolution leading to development and degradation of environment. Dependence on energy for all development.*
- *How technology can be used to generate a more equitable use of resources and build environmental sustainability.*

- (ii) Renewable energy: limitations of conventional sources; sources of renewable energy and their features (solar, wind, biomass, micro-hydel and muscle power).

*Limitations of conventional sources of energy such as - coal, natural gas and oil (extraction, transportation, storage, pollution and degradation of environment).*

*Renewable Energy: What is renewable energy; sources of renewable energy, their features and uses: biomass, solar energy, wind energy, hydel energy, geothermal energy – advantages and disadvantages of renewable energy sources.*

- (iii) Health: incidents of disease as an indicator of the health of the environment; prevention of diseases by better nutrition, sanitation, access to clean water, etc.; communicable and non-communicable diseases; techniques of low cost sanitation; policy and organisation to provide access to basic health service for all; the role of traditional and local systems of medicine.

- *Diseases as indicators of health of the Environment: Malaria – standing water, felling of trees. Enteric diseases – contaminated water. Respiratory diseases – air pollution.*
- *How diseases can be prevented by better nutrition, sanitation and access to clean water.*
- *Role of sanitation, water supply, good nutrition in maintenance of health and prevention of diseases: Prevention of deficiency diseases and water borne diseases.*
- *Definition of communicable and non-communicable diseases.*

- *Communicable diseases: HIV/AIDS, Tuberculosis, Malaria, Hepatitis as examples. Causative agents, transmission and prevention of each of the above.*
- *Non communicable diseases: Cardiovascular disease, diabetes, skin cancer, scurvy and rickets (mal nutrition), and Chronic Obstructive Pulmonary Diseases (COPD)- causes related to environment and lifestyle.*
- *Some techniques of low cost sanitation, eg. Decomposition system (pit latrine and ventilated improved pit latrines) and Dry sanitation method.*
- *Organization of health services in India. Facilities provided by the government for basic health services in India (to be covered briefly).*
- *A brief introduction to traditional systems of medicine, e.g.: ayurveda, unani and local health traditions. Their role in maintaining health of the community.*

(iv) *Biotechnology: potential; limitations.*

- *Explanation of the term “Biotechnology”.*
- *Use/potential of Biotechnology in the field of medicine, industry, manufacturing and agriculture.*
- *Any **five** limitations of biotechnology application.*
- *Bioremediation.*

### **SECTION C**

#### **6. Design and Planning for Environmental Conservation and Protection**

(i) *Ecosystem analysis: understanding complex systems; critical and state variables as system indicators; indicators of inter-relationships; successions and systems resilience; predicting and assessing system responses to impacts and their interventions; rapid appraisal methods.*

- *Understanding of the term Ecosystem analysis.*
- *Composition of the ecosystem – multiple biotic and abiotic factors that influence each other. Understanding of limiting factors and zone of tolerance. Various factors which are considered as critical variables.*
- *Definition and components of state variables.*
- *Succession: primary and secondary – system resilience.*
- *What are indicator species – examples, trouts as indicators of water quality, butterflies as indicators of habitat loss and fragmentation.*

(ii) *Human environment interactions: quantity of life vs. quality of environment; environmental issues and problems; role of belief and values; analysing brief statements for underlying values; issues analysis - separating symptoms from problems; problem identification; identifying the players and their positions; understanding interacting problems and identifying critical control points; problems analysis; identifying variables (human behaviours, values, ecological, etc.); determining the relationships between variables; formulating questions for research; planning research; generating problems, solution, briefs and specifications.*

- *Understanding the state of the environment and the major environmental problems of the 21<sup>st</sup> century.*
- *The role of belief and values in creating maintaining and solving environmental problems.*

*A case study to be done by the students based on the following points:*

- *Identification of an environmental issue in their city/ town/ village.*
- *Identification of the factors/ people responsible for this issue.*

- *Contribution of the local authority / government to curb this problem.*
- *Identification to the critical points that have led to the problem.*
- *Urban and rural variations.*
- *Steps to be followed in doing an 'Action Research' on any environmental problem.*

(iii) Evaluation and assessment of impacts: approaches and techniques of environment and social impact assessment; environment impact assessment as a planning tool and a decision making instrument; interpreting environment impact assessments.

- *Definition and objectives of 'Environment Impact Assessment' (EIA).*
- *EIA framework –*
  - *Necessity- screening*
  - *Key issues- scoping and focusing*
  - *What to study – assessment*
  - *Impact/ identification/evaluation of significance – evaluation*
  - *Identification of mitigating means – mitigation*
  - *Report preparation – documentation*
  - *Reviewing - monitoring*

- *Designing an EIA for the following:*
  - *Proposed construction of a dam (Social impact, Ecological impact).*
  - *Proposed resort by the sea (Ecological impact).*
  - *Proposed residential complex close to a forested area / national park in India (Ecological impact).*

*[Interpret the EIA as a good planning and decision making tool].*

(iv) Design of solutions: generating solution options; overcoming blocks in thinking; generative and lateral thinking; using criteria (social, political, ecological, technological, economic) to rank and prioritise solution ideas; check solutions for economic, social and technical viability; collation of solution into coherent plans; planning sequence and cost.

*Self-explanatory.*

*To be taught through case studies only. Students should be encouraged to think creatively and develop solutions for environmental problems. (For better understanding, not for testing).*

## **PAPER II - PRACTICAL/PROJECT WORK**

Guidelines for Practical/Project Work are given at the end of this syllabus.

## CLASS XII

There will be **two** papers in the subject:

**Paper I:** Theory - 3 hours... 70 marks

**Paper II:** Practical/ Project Work - ... 30 marks

### PAPER I - THEORY

There will be one written paper of three hours duration carrying 70 marks divided into two parts.

**Part 1 (20 marks)** will consist of **compulsory** short answer questions on the entire syllabus.

**Part 2 (50 marks)** will consist of three sections. Each section will have **three** questions. The candidates will be expected to answer **five** questions in all choosing at least one from each section.

**Project work** will carry **30 marks**. The project needs to be done under the supervision of the teacher. The project work will be evaluated by a **Visiting Examiner** (who has expertise in that specific area), appointed locally and approved by the Council.

### SECTION A

#### 1. Human Beings and Nature

- (i) Modern schools of ecological thought.
- (ii) Deep ecology (Gary Snyder, Earth First) vs. shallow ecology.
- (iii) Stewardship of land (e.g. Wendell Berry).
- (iv) Social ecology [Marxist environmentalism and socialist ecology (Barry Commoner)].
- (v) Feminism.
- (vi) Green Politics (e.g. Germany and England).
- (vii) Sustainable Development.

*Modern schools of ecological thought; definition and basic understanding of Deep Ecology as opposed to Shallow Ecology; Stewardship, Social Ecology - Marxist environmentalism and Socialist Ecology, Eco feminism, Green political movements of Germany and England and Sustainable Development (basic concepts).*

*A brief look at the above in terms of definition, origin, basic principles and environmental orientations.*

*Special reference to principles of Deep Ecology (Gary Snyder) and Laws of Ecology (Barry Commoner)*

*Gary Snyder, Barry Commoner, Wendell Berry - a short biographical sketch particularly with reference to their work on the environment.*

*Earth First – a brief understanding of the organization's ethos and work.*

*World Wide Fund for Nature – organisation, mission, strategy for conservation.*

*Greenpeace – organisation, mission statement, core values, objectives and strategy.*

#### 2. Population and Conservation Ecology

- (i) Population dynamics: factors causing population change (birth, death, immigration and emigration); relation between the factors; age structure and its significance; population pyramids; survivorship curves; three general shapes r and K strategies.

*Factors causing population change (birth, death, immigration and emigration); relation between the factors; Age structure and its significance; Population Pyramids – interpretation and implications. Rate of change of population – the three general shapes of Survivorship Curves, r and K strategies and differences between the two.*

- (ii) Human populations (Malthusian model and demographic transition).

*Definition of Carrying Capacity; Malthusian view: concept of 'over-population' and shortage of resources; Questioning Malthus. Population Growth vs. Disparate Consumption of resources within and amongst nations. Definition and understanding of Demographic Transition; Factors influencing demographic transition.*

- (iii) Population Regulation: growth without regulation (exponential); simple population regulation (logistic growth curve); factors regulating population size (space, food and water, territories, predators, weather and climate, parasite and diseases, disasters and self-regulation).

*Basic understanding of the Exponential growth curve (J – shaped) and Logistic growth curve (S - shaped); Factors regulating population size (space, food and water, territories, predators, weather and climate, parasite and diseases, disasters and self-regulation).*

- (iv) Human population control: family planning; education; economic growth; status of women.

*Strategies for human population control with emphasis on women's empowerment. (Details of methods of family planning **not required**.)*

- (v) Threats to the ecosystem: habitat destruction; genetic erosion; loss of diversity; expanding agriculture; impound water; waste from human societies; increasing human consumption.

*Only a brief understanding of the causes and consequences of threats to provisioning and regulatory functions of the ecosystem with suitable examples.*

- (vi) Conservation: importance; the critical state of Indian forests; conflicts surrounding forested areas - populations and tribals and their rights - tourism - poaching - roads - development projects - dams; scientific forestry and its limitations; social forestry; the role of the forest department; NGOs; joint forestry management; wild life - sanctuaries, conservation and management in India; Project Tiger as a case study in conservation.

*Definition of: Conservation, in situ and ex situ conservation. Importance of Conservation.*

*In-situ conservation: Wildlife sanctuaries, National parks, Biosphere reserves (definition, objectives, features, advantages and disadvantages).*

*Ex-situ conservation: zoos, aquaria, plant collection (objectives, features, advantages and disadvantages).*

*Conflicts in managing and conserving Forests: India's forest cover, issues concerning people living in and around forests with particular reference to tribal rights; threats to forests: poaching,*

*developmental projects like roads and dams, over exploitation of forest resources (direct and indirect).*

*The role of the forest department and NGOs in managing forests.*

*Some management measures: scientific forestry, social forestry (various types of social forestry), Joint Forestry Management (JFM), ecotourism.*

*Definition, scope, advantages and disadvantages of each of the above.*

*Project Tiger as a case study in conservation: Origin, aims, and objectives, successes, failures.*

### 3. Monitoring Pollution

- (i) Pollution monitoring.

*Primary and secondary pollutants. Importance of monitoring air pollution including Ambient Air Quality Monitoring (gaseous and particulate). Concept of carbon credits and carbon trading in regulating emissions. Causes for excessive vehicular pollution and various steps taken to regulate pollution-emission standards for new vehicles, implementation of CNG programme, inspection & maintenance programme for in-use vehicles, phasing out of old commercial vehicles and promotion of public transport.*

- (ii) Monitoring the atmosphere: techniques.

*Monitoring at emission source and of ambient air quality, criteria for monitoring stations, types of stations, number of stations, frequency of data collection, characteristics of ambient air sampling, basic consideration for sampling (to be dealt with in brief). Classification of techniques- manual and instrumental. Manual-Passive samplers, High Volume Samplers and Bubbler Systems. Instrumental-photometric techniques-NDIR, Chemiluminescence - principle and use.*

- (iii) International and national air quality standards.

*National Ambient Air Quality Monitoring (NAAQM); the main functions of the Central Pollution Control Board and the State*

*Pollution Control Board, objectives of air quality standards, New name of NAAQM, National Air Monitoring Programme (NAMP) objectives of the NAMP.*

*Definition of air quality standards and importance; National air quality standards for gases/particulate matter covered under WHO guidelines.*

- (iv) Water testing: indicators of water quality.

*Indicators (electrical conductivity, turbidity, pH, dissolved oxygen, faecal waste, temperature, hardness, nitrates and sulphates) the significance of each and their interpretations. B.O.D. and C.O.D., theoretical concept only (lab work for better understanding and not for testing)*

- (v) Soil testing: indicators of soil type and quality and laboratory work.

*Soil indicators- the characteristics of a good soil indicator, the three basic types of soil indicators- biological, physical and chemical, two examples of each. The information provided by each of these types of indicators. Definitions, effects and experiments to find out soil respiration, soil pH, soil aggregate, infiltration rate and simple methods of controlling each of these.*

## SECTION B

### 4. Third World Development

- (i) Urban-rural divide: urbanisation - push and pull factors; consequences on rural and urban sectors; future trends and projections.

*Causes of migration - push and pull factors, consequences on rural and urban areas and ways to reduce migration. Future trends and projections.*

- (ii) A critical appraisal of conventional paradigm of development from the viewpoints of sustainability, environmental impact and equity.

*Definition of Development.*

*An understanding that development has become synonymous with growth. This approach has the following impacts on the environment: (a) Ignoring negative*

*environmental impacts; (b) Changing patterns of resource use due to market pressures; (c) Overuse and exploitation of resources; (d) Diversion of scarce resources to luxury goods; (e) Disparate access to resources; (f) Increasing wastes and pollution.*

*The above to be explained with suitable examples.*

- (iii) A case study of Gandhian approach in terms of its aims and processes.

*Local self-governance – basic principles behind village policy, Antodaya, Sarvodaya, Panchayati Raj; local self-sufficiency, local markets and environmental sustainability. Village as the basis of development; promotion of cottage industries and intermediate technologies; focus on employment.*

*The above to be contrasted with today's paradigm of growth.*

- (iv) Urban environmental planning and management: problems of sanitation; water management; transport; energy; air quality; housing; constraints (economic, political) in tackling the problems; inapplicability of solutions that have worked in the First World and the need for indigenous approach to urban environment.

*A basic understanding of the following urban environmental problems: problems of sanitation, water management, transport, energy; air quality and housing.*

*Awareness of some indigenous solutions: Rainwater harvesting, garbage segregation, composting, energy from solid and liquid wastes, sewage management (dry toilets, Decentralized Water Management System (DEWATS))*

*Features of new urbanism, goals of smart growth. The following examples of urban planning and management from the third world to be studied:*

- *Bogota – Bolivia (Traffic Management);*
- *Cuba (Urban agriculture using organic methods);*



- *Curitiba – Brazil (Traffic planning and urban renewal using innovative measures);*
- *Cochabamba – (Water management and protests against privatisation of water supply).*

## 5. Sustainable Agriculture

- (i) Traditional Agriculture in India: irrigation systems; crop varieties; techniques for maintaining soil fertility; impact of colonialism; Indian agriculture at independence - food scarcity - food import - need for increasing production - the need for land reform; green revolution - HYVs - fertilizers - pesticides - large irrigation projects (dams); critical appraisal of the green revolution from the viewpoints of agro-bio diversity; soil health; ecological impact of pesticides; energy (petroleum and petrochemicals); ability to reach the poorer sections of the rural communities; sustainability - need for sustainable agriculture - characteristics for sustainable agriculture; techniques of water soil and pest management.

*Definition of the following terms: traditional agriculture, natural farming, organic agriculture, modern agriculture (use of hybrid seeds, high yielding varieties, chemical fertilizers and pesticides), gene revolution (genetically modified seeds) and sustainable agriculture.*

*Irrigation systems:*

*Macro vs micro irrigation systems - canal irrigation/dam as compared to sprinkler/drip/ trickle drip/dug wells. Basic features, advantages and disadvantages of each kind. Traditional rainwater harvesting- tankas, khadins, ahar, pynes, zings, johads and eris (suitability of each type in the particular region).*

*Features of pre-colonial agriculture in India: growing for sustenance rather than market; multi-cropping, management of soil health, diversity in seed.*

*Colonial influence: punitive taxation, commercial crops for export and British industry, devaluation of sustainable*

*traditional practices. Bengal famine. Comparative study of pre-colonial, colonial and post- colonial agriculture and their impact.*

*Green Revolution: Origin (food scarcity - food import - need for increasing production).*

*Basic principles of Green Revolution-Development of High Yielding Varieties (HYV); introduction of fertilizers and pesticides; mono cropping.*

*Environmental, social and economic impacts -advantages and disadvantages (from the viewpoints of agro-bio diversity; soil health; ecological impact of pesticides; energy use; input costs; benefits to small and medium farmers, community level and household level food security).*

*Land reform – need, advantages, failures and successes.*

*Elements of sustainable agriculture: Mixed farming, mixed cropping, inter-cropping, crop rotation, use of sustainable practices of water soil and pest management for improving soil fertility (organic fertilizers, bio-fertilizers, green manure, with two examples) and pest control (bio pesticides). Integrated Pest Management (IPM); eating local foods*

*Management of agricultural produce: Storage; Food preservation-different methods like use of low temperatures, high temperatures, drying, canning, preservation by salt and sugar. Transportation of Food.*

*Food processing - Definition, food preservation, packaging, grading.*

*Food adulteration and Food additives-definitions; types of adulteration, harmful effects of adulteration.*

*Quality Marks - ISI (Indian Standard Institute); AGMARK (Agricultural Marketing); FPO(Fruit Product Order) - a brief explanation only.*

- (ii) Food: the twin problems of production and access; food situation in the world; integrated and sustainable approach to food security for the Third World. Food Security.

*Meaning of Food Security, need for food security. The problems in attaining food security - those of production, storage and access. Integrated and sustainable approach to food security for the Third World including working for environmental sustainability and social and economic sustainability through land reform, credit support to farmers, market support to farmers, inadequacies in the present marketing system, ways to improve marketing system, improving access to food, ownership of seeds.*

*An understanding that national level food security may not translate into household and community level food security or long term environmental sustainability unless the above factors are addressed. Main features of the Food Security Law 2013.*

### SECTION C

#### 6. Environmental and Natural Resource Economics

- (i) Definition: resources; scarcity and growth; natural resource accounting.

*Classification of natural resources - on the basis of origin (abiotic and biotic), on the basis of renewability (renewable and non-renewable), on the basis of development (potential and actual), on the basis of distribution (ubiquitous and localized); scarcity and growth, natural resource accounting.*

*Classification of resources as renewable and non-renewable.*

*Definition, basic principles, advantages and disadvantages of Physical accounting.*

- (ii) GNP vs. other forms of measuring income.

*GDP, GNP – definitions, advantages and disadvantages of using them as tools for measuring growth.*

- (iii) Economic status and welfare (net economic welfare, nature capital, ecological capital, etc.)

*A broad overview of the purpose of environmental economics.*

*Definition and classification: Defensive expenditure (its classification); natural/ecological capital.*

- (iv) Externalities: cost benefit analysis (social, ecological).

*Externalities – definition, kinds (positive and negative), impacts.*

*Cost Benefit analysis - Definition, the process in brief, advantages and disadvantages.*

*EPR (Extended Producer Responsibility) - definition, examples, advantages.*

- (v) Natural capital regeneration.

*What is natural capital? Kinds of natural capital; classification of ecosystem services, causes of degradation (acid deposition, air pollution, deforestation, loss of biodiversity and emission of carbon dioxide), ecological footprint and man's disproportionate use of natural resources, importance of preserving and regenerating natural capital.*

#### 7. International Relations and the Environment

- (i) Trans-national characteristics of environmental issues using case study of Amazonia, Trade in Wildlife and Ozone Depletion.

*Case study of Amazonia - causes for exploitation of forests, reasons for acceleration of deforestation, effects of government policies, ecological value of rainforests and possible solutions to the problem.*

*Case study of ivory trade in Africa - reasons for flourishing trade of ivory in the past, steps taken to curb the trade and the consequences of ban in trade.*

*Case study of ozone depletion - what is meant by ozone layer and how does it get depleted, (Chapman's cycle), potential effects of ozone depletion, common ozone depleting substances (halons, carbon tetrachloride, CFCs, methyl chloroform, methyl bromide and HCFCs) and their life span in the atmosphere; Ozone hole; steps taken to control ozone depletion.*

- (ii) Impact of international politics, national sovereignty and interest.

- (iii) International trade: a theoretical perspective; free trade vs. protectionism; import barriers; domestic industry vs. free trade; transnational companies - a historical perspective (colonialism and its lasting impact today); trade between the first and the third world - characteristics - terms of trade; India's

international trade - characteristics - major imports and exports - foreign exchange crises - the export imperative and its impact on the environment; the case study of aquaculture in India; diversion of scarce resource from production of subsistence needs to commercial products; toxic waste trade - extent and impact; Globalisation - trade regimes (WTO, GATT, IPR) and their impact on third world.

*Definition, advantages and disadvantages of globalization, free trade, protectionism.*

*Transnational Companies (TNCs) – definition; TNCs and environment – conflict of interest.*

*History of third world countries' trade with the developed countries (with special reference to India) with regards to composition and terms of trade (export of primary goods and import of finished goods at higher cost- tapping of primary goods leading to environment degradation- open cast mining, agriculture, aquaculture, etc.).*

*Case study of aquaculture in India to understand the impact of free trade.*

*Economic allocation of scarce resources and its impact on environment.*

*Toxic waste trade – definition, origin, factors sustaining, impact on third world countries (example – health and environmental impacts) and steps to mitigate it (Bamako and Basel Conventions).*

*GATT – the organization and its metamorphosis into WTO.*

*Principles and functions of WTO: creating a level playing field for international trade through MFN (Most Favoured Nation), NT (National Treatment) and reduction of import barriers - tariff and non tariff barriers and trading to comparative advantages.*

*Full forms of and areas addressed in the WTO GATT, TRIPS, TRIMS, Agreement on Agriculture (AOA). A brief understanding of how these agreements impacted India's trade, food security, economic well-being, environmental sustainability.*

*Definition of IPR and its categories: copyrights, patents, trademarks, industrial design rights, geographical indicators and trade secrets.*

*A brief understanding of each of the above categories.*

(iv) International aid: agencies; advantages; limitations; need for re-orienting aid; aid vs. self-reliance.

*International aid – advantages and disadvantages; Types of Aid: Tied and Untied Aid - advantages and limitations of each.*

## PAPER II

### PRACTICAL/PROJECT WORK – 30 MARKS (FOR CLASSES XI & XII)

The practical/project work carrying 30 marks needs to be undertaken under the guidance of the teacher. The project will be evaluated by a Visiting Examiner (who has specific expertise in the content of the project work) appointed locally and approved by the Council.

The project work could take **one** of the five forms:

1. Address a current environmental problem (preferably at local or regional scale) and should include problem identification and analysis, use of secondary data as well as some collection of primary data, design of solution, documentation of the entire process in the form of a solution proposal.
2. Design and conduct an environment impact assessment. The candidates may use secondary data, demonstrate their capacity to collect and analyse primary data by incorporating some primary data collected and use it in a few sectors of their work.
3. Systematic monitoring of an aspect of the local environment over a period of at least six months. The candidate must use quantitative techniques of monitoring, sampling scientifically. The data collected must be interpreted and presented in the report.
4. Field work and training in an environmental organisation (NGOs, Industrial Pollution Control Firms, Testing Laboratories, etc.) for a period of not less than one month. This work should be focused on one area in the syllabus. The candidate will produce a paper on the area of his/her work and training which will include his/her experience and the special expertise that she/he has acquired.
5. Conduct a study on the density and population of plants growing in a particular area using the quadrat method.

**NOTE: No question paper for Practical work will be set by the Council.**

# BIOTECHNOLOGY (878)

## Aims:

1. To enable candidates to acquire the knowledge and develop an understanding of how materials are provided by biological agents to provide goods and services.
2. To appreciate the role played by biotechnology in improving health care for human beings.
3. To understand the interdisciplinary nature of this subject.
4. To create awareness about the appreciation of biological processes to industries.
5. To develop the ability to appreciate biological phenomenon in nature and the contribution of biotechnology to human welfare.
6. To develop scientific attitude towards biological phenomenon.

## CLASS XI

There will be two papers in the subject:

Paper I: Theory..... 3 hours ... 70 marks

Paper II: Practical..... 3 hours ... 15 marks

Project Work..... ...10 marks

Practical File..... ...5 marks

### PAPER I –THEORY- 70 Marks

There will be **one** paper of **three** hours duration divided into **two** parts.

**Part 1 (20 marks)** will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

**Part 2 (50 marks)** will consist of **eight** questions out of which the candidates will be required to answer **five** questions. Each question in this part shall carry 10 marks.

#### 1. Introduction to Biotechnology

- (i) Historical background; definition; a brief introduction of the traditional and modern techniques of Biotechnology and their applications.

*Definition of biotechnology by OECD and EFB; contributions of Karl Ereky and Louis Pasteur; use of various fermented products in ancient civilisations;*

*Kitchen (traditional), the first biotechnological laboratory -reasoning behind the technology involved in simple biological products like curd and beer; names of microorganisms involved in their production.*

*Application of these technologies for large-scale production, with special reference to fermentation (Beer production only). Quality control management of the products, good laboratory practices.*

- (ii) Scope and importance of biotechnology; different branches of biotechnology and different regulatory guidelines; ethical, legal and social issues (ELSI) that a biotechnologist comes across while doing the work. Various organisations in the field of biotechnology.

*Names, definitions and importance of various fields that can be covered under biotechnology such as - agricultural/ plant biotechnology, animal biotechnology/medical biotechnology, nanobiotechnology, industrial biotechnology, immunology and health care, energy and environment.*

*Intellectual Property Rights (IPRs) in biotechnology- concept of intellectual property, types of IPR and its need; intellectual property rights and the choice of intellectual property rights protection. Discovery and invention; Concept of patenting, trademark, trade secrets, copyright, geographical indications and PBRs and their need.*

*Concept of ethical, legal and social issues with one common example IVF.*

*Biosafety issues: release of genetically modified organisms into the environment and their impact; GEAC and its objectives.*

*Biotechnology - global and Indian scenario. Various institutes, centres and funding agencies - NBTB, CCMB, ICGEB, ICMR, ICAR, DBT, DST which deal with biotechnology and bioinformatics in India: names only.*

- (iii) Basic concepts of Biochemical technology and biostatistics: What does the biochemical technology mean? An understanding of various statistical methods involved in biotechnology.

*Concept of buffer, type and preparation of buffers, pH, physical variables; fermentation; An understanding of bio-reactors, idea of sampling – quadrat and transect; measures of central tendency – mean, median, mode; standard deviation and standard error; concept of probability – theoretical and experimental.*

## 2. Cell Biology

- (i) Cell: Justification of cell as a basic unit of life. Prokaryotic cell and eukaryotic cell; A brief note on the cell components with special reference to nucleus. Various cytological techniques used in identifying the cell and chromosomes.

*Differentiation prokaryotic and eukaryotic cellular systems.*

*Structure of bacteria (in brief, with reference to plasmid). Gram+ and Gram- bacteria.*

*An understanding of cell components, their **basic** structure and functions - cell wall, cell membrane, cytoplasmic reticulum, Golgi apparatus, mitochondria, ribosomes, vacuoles, plastids, lysosomes, nucleus and other important inclusions of the cell.*

*Chromosomal structure and composition – organisation of chromatids, concept of homologous and non-homologous chromosomes, sister and non-sister chromatids, classification of chromosomes on the basis of position of the centromere on the chromosome, basic idea about telomere, chromatin and nucleosome. An idea about banding patterns (Q, R, C and G) and their application.*

*Concept of chromosomal number in different species, e.g. man, mouse, Drosophila and pea.*

*Techniques in cytology – microscopy (light and electron microscope), karyotyping and centrifugation (principle and applications only).*

- (ii) Cell Division and cell cycle: types of cell divisions and various other activities of cell such as biochemical transformations.

*Types and significance of cell division and a brief note about the different stages of cell division – mitosis and meiosis.*

*Basic concept of cell cycle and cell cycle regulation – CdK method only, definition of Mitotic Index.*

*Biochemical Transformations:*

*An understanding of biochemical transformations, different biochemical pathways involved in respiration - aerobic and anaerobic.*

*Aerobic respiration - Glycolysis, Krebs' cycle, electron transport chain and oxidative phosphorylation.*

*Anaerobic respiration - lactic acid, fermentation and alcohol fermentation – definition only.*

- (iii) Errors in cell division: what happens if the cell does not divide normally? An understanding of different numerical and structural abnormalities.

*Concept of mutation: causes; types –somatic, germinal, spontaneous, induced, gene, chromosomal and genomic mutations, euploidy, aneuploidy, monosomy, nullisomy, trisomy and tetrasomy; various factors causing mutations.*

*Concept of non-disjunction: meiotic non-disjunction and mitotic non-disjunction. Non-disjunction in sex chromosomes – Turner's syndrome and Klinefelter's syndrome - chromosomal composition and symptoms only.*

*Numerical chromosomal aberrations with respect to autosomes, i.e. Down's syndrome – chromosomal composition and symptoms only.*

*Structural chromosomal abnormalities – deletions, duplications, translocations, inversions.*

*Polyploidy and its significance in plants.*

*Inborn errors of metabolism - basic concept and examples like albinism, sickle cell anaemia, phenylketonuria and alkaptonuria.*

### **3. Biomolecules and related techniques**

- (i) Introduction to biomolecules- definition and types. Carbohydrates, proteins, lipids, vitamins and enzymes – their structure and properties.

*Biomolecules – definition and types*

*Structure and functions of carbohydrates.*

*Sugars and derivatives; classification of some important mono, di and polysaccharides - glucose, fructose, glycogen, cellulose, chitin and peptidoglycan. Physical and chemical properties of sugars.*

*Structure, functions and classification of proteins i.e. simple, complex and derived; building blocks of proteins - the amino acids: chemical structure, types (acidic, basic and neutral); physical and chemical properties of amino acids. 3D - structure of proteins. Different types of protein structures - primary, secondary (alpha helix, beta pleated sheet and random structures), tertiary, quaternary; protein sequencing by MALDI-MS.*

*Structure and functions of lipids – fatty acids and alcohol; types (simple, conjugated and derived lipids with one example of each); chemical and physical properties of lipids.*

*Vitamins: Definition, types (fat soluble and water soluble vitamins); co-enzyme forms of water soluble vitamins; deficiency diseases of vitamins.*

*Enzymes: Structure and functions of enzymes: chemical nature of enzymes; characteristics and properties of enzymes. An understanding of enzyme activity on the basis of activation*

*energy; mechanism of enzyme action - lock and key model; induced fit hypothesis; factors affecting enzyme activity (temperature, pH, substrate concentration, enzyme concentration, inhibitors (competitive, non-competitive).*

*Optical activity of biomolecules (dextrorotatory and laevorotatory).*

*Concept of supramolecular assembly.*

- (ii) Techniques used for separation of biomolecules

*Ion exchange chromatography and paper chromatography.*

### **4. Developmental Biology and Immunology**

- (i) Animal and plant development: development of an organism from zygotic cell in both plants and animals.

*Animal development – fertilisation, zygote to blastocyst formation.*

*Plant development. Double fertilisation including formation of primary endosperm nucleus.*

- (ii) An understanding of defence strategies in living organisms.

*Immune system in higher animals, concept of immunity, immunisation, antigen and antibody. Various cells involved in immune response in humans. An introduction to human leukocyte antigens with reference to organ transplantation; Types of immunity - innate and acquired. ELISA Technique (Enzyme Linked Immuno Sorbent Assay).*

*Secondary metabolites in plants and their significance*

*Defence strategies in bacteria – endospores and R plasmids.*

### **5. Genetics**

- (i) Laws of Inheritance: An account of Mendel's experiments. Different types of genetic inheritance.

*Mendel's experiment on pea plant and his laws of inheritance.*

*Concept of trait, gene, allele, phenotype, genotype, homozygosity, heterozygosity and hemizyosity. Types of inheritance: autosomal inheritance - dominant, co-dominant, recessive, polygenic, pleiotropic and cytoplasmic inheritance (plastidial inheritance).*

*Pedigree construction using different standard symbols.*

*Sex chromosome inheritance - with special reference to X chromosomal inheritance with suitable examples (colour blindness and haemophilia).*

- (ii) Gene Mapping: mapping of genes on chromosomes using linkage analysis. Cancer and its genetics.

*Mapping of genes on chromosomes with respect to COV (Crossing Over Value).*

*Basic concept of linkage (types not required) and crossing over. Genetic recombination.*

*Cancer: Causes (physical, chemical, biological – TSG and oncogenes); diagnosis and treatment.*

- (iii) Genes in populations: how do genes behave in populations from generation to generation? Various ways of studying population genetics.

*Concept of gene pool and allele frequency, definition of Hardy Weinberg law, its applications.*

*Possibility of disease resistant and susceptible genes in population. Definition and application of pharmacogenetics and pharmacogenomics.*

## PAPER II

### PRACTICAL WORK – 15 Marks

Candidates are required to complete the following experiments.

1. Determination of blood group by using antisera.  
*The students can perform this experiment on their own blood groups. Proper instructions however are to be given for 'prick' – e.g. (a) Sterilize finger with alcohol/disinfectant. (b) Use only disposable sterile needle. (c) Use the needle*

*only once and destroy it. (d) Do not prick or use blood drop in an indiscriminatory way.*

2. Identification of different types of blood cells by preparing blood smear using Leishmann's stain.

*Requirements: Blood sample, disposable needles, slides, Leishmann's stain. Make a blood smear on a slide, use the stain to colour the smear, wash and observe under microscope.*

3. Instruments – their names, use and principles (if applicable).

*Water bath, pH meter, weighing balance, desiccators, microfiltration unit, magnetic stirrer, LAF, haemocytometer, micropipette, vortex mixer, colorimeter/spectrophotometer, hot air oven, autoclave, incubator, electrophoresis chamber, colony counter, autoclave, hot plate.*

4. Finding out the pH of water by using pH meter or pH paper on tap water and water containing acid, base.

*Take tap water in three test tubes, add two drops of dil. HCl in one, two drops of NaOH in the second while leaving the third test tube with tap water. Use pH meter or pH paper to find their specific pH.*

5. Observation of steps of mitosis by using the root tip of onion.

*The students should be given practice in preparing slides for study of mitosis by crush smear method. They should be able to identify different stages (at least four stages). The requirement for this set of experiments is Acetocarmine stain slides, coverslips, microscopes and spirit-lamp.*

6. Measurement of mitotic index.

*Mitotic index is the ratio of number of cells undergoing mitosis to the number of cells in the field.*

$$MI = \frac{\text{No. of cells showing mitosis}}{\text{Total no. of cells in the field}}$$

7. Observation of various stages of meiosis under microscope.

*For the study of meiosis, the students should be shown permanent slides of meiosis and they should be able to identify at least six stages of meiosis from the slides.*

8. Effect of temperature on curdling of milk by using *Lactobacillus* bacteria at 37°C, 60°C and 10°C.

*Optimum temperature for curdling of milk is 37°C due to active form of bacteria at this temperature; it is inactive at low temperature and dies at high temperature.*

9. Food tests:

- (i) *Carbohydrates – starch by iodine solution turning blue - black in colour.*

*Reducing and non-reducing sugars by using Fehling's solution / Benedict's solution – reducing the cupric ion (blue) to cuprous ion (red).*

- (ii) *Protein test – Biuret test, Xanthoproteic and Millon's test*

- (a) **For Biuret test** – *The protein produces deep blue – violet colour due to the involvement of cupric ion in the product formed.*

- (b) **For Millon's Reagent** – *A pinkish red colour is observed with mercuric chloride.*

- (c) **For Xanthoproteic Test:** *When concentrated nitric acid is boiled with protein a yellow colour is observed. On addition of ammonium hydroxide or liquor ammonia orange yellow precipitate is obtained.*

- (iii) *Lipids – Sudan III, Acrolein test, paper test*

- (a) *Sudan III is a red fat-soluble dye used for identification of the presence of lipids, triglycerides and lipoproteins. It reacts with the lipids or triglycerides and gives red colour.*

- (b) *Acrolein test is used to detect fat. When fat is heated strongly in the presence of potassium bisulphate/ sodium bisulphate ( $KHSO_4/NaHSO_4$ ) that acts as a dehydrating agent, the glycerol is dehydrated to form an unsaturated aldehyde called acrolein that gives a pungent and irritating odour.*

10. Finding out the purity of milk by using lactometer.

*Put the instrument in milk. If it sinks down and reaches the mark 'M' mentioned on lactometer, it means that the milk is pure or if not, it means that the milk is impure. If the milk is mixed with water, it would sink higher than mark 'M'. If it stands at the mark 3 it means that the milk is 75% pure and respectively 2 for 50% purity and 1 for 25% purity.*

11. Construction of pedigree showing different types of inheritance.

*The students are to observe the traits like, rolling of the tongue/ attached earlobe/ widow's peak.*

12. Preparation of karyotypes.

*Demonstration of any metaphasic plate of mitosis.*

13. Sampling methods – quadrat and transect by using different techniques.

*To be done in groups. Use yellow and green pea seeds. Make a quadrat (30 cm X 30 cm) with blocks of 6 cm X 6 cm. Spread the seeds randomly on the table top. Put the quadrat and count the number of yellow and green peas per block; find the frequency of each type of pea seed.*

14. Data collection – primary and secondary.

*Collect any type of primary data and secondary data, tabulate the data and draw conclusion.*

## PROJECT WORK AND PRACTICAL FILE

– 15 marks

### Project Work – 10 Marks

Candidates are to creatively execute **one** project/assignment on any aspect of Biotechnology. Teachers may assign or students may choose any one project of their choice. The report should be kept simple, but neat and elegant.

### Practical File – 5 Marks

Teachers are required to assess students on the basis of the practical file maintained by them during the academic year.



## LIST OF ABBREVIATIONS

1. CCMB: Centre for Cellular and Molecular Biology
2. CdK: Cyclin dependent Kinase
3. COV: Cross Over Value
4. CSIR: Council of Scientific and Industrial Research
5. DBT: Department of Biotechnology
6. DST: Department of Science and Technology
7. EFB: European Federation of Biotechnology
8. ELISA: Enzyme Linked Immuno Sorbent Assay
9. ELSI: Ethical, Legal and Social Issues
10. ETS/ETC: Electron Transport System / Electron Transport Cycle
11. FMN/FAD: Flavin Mono Nucleotide / Flavin Adenine Dinucleotide
12. GEAC: Genetic Engineering Approval Committee
13. HLA: Human Leucocyte – associated Antigen
14. ICAR: Indian Council for Agricultural Research
15. ICGEB: International Centre for Genetic Engineering and Biotechnology
16. ICMR: Indian Council for Medical Research
17. IEF: Iso Electro Focussing
18. IPP: Intellectual Property Right Protection Act
19. IPR: Intellectual Property Right
20. IVF: In–Vitro Fertilization
21. MALDI-MS: Matrix Assisted Laser Desorption Ionization – Mass Spectrometry
22. MI: Mitotic Index
23. NADPH/NADP: Nicotinamide Adenine Dinucleotide Phosphate (reduced) / Nicotinamide Adenine Dinucleotide Phosphate
24. NBTB: National Biotechnology Board
25. OECD: Organization for Economic Cooperation and Development
26. PBR: Plant Breeder’s Right
27. TPP: Thiamine Pyrophosphate
28. TSG: Tumour Suppressor Gene

## CLASS XII

There will be two papers in the subject:

**Paper I:** Theory..... 3 hours ... 70 marks

**Paper II:** Practical..... 3 hours ... 15 marks

Project Work..... ...10 marks

Practical File..... ... 5 marks

### PAPER I: THEORY- 70 Marks

There will be **one** paper of **three** hours duration divided into **two** parts.

**Part 1 (20 marks)** will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

**Part 2 (50 marks)** will consist of **eight** questions out of which the candidates will be required to answer **five** questions. Each question in this part shall carry 10 marks.

#### 1. Molecular Biology

- (i) Nucleic acids and their estimation: an understanding of nucleic acids, their biochemical structure.

*DNA as the genetic material (Hershey and Chase experiment).*

*DNA (B-DNA)– physical and chemical structure; definition, double helical model of DNA, (Watson and Crick's); Nucleotide and nucleoside; Chargaff's Law, method of replication of DNA, various replicative enzymes in both prokaryotic and eukaryotic organisms, example topoisomerases, helicase, SSBs polymerases, primases, ligases. Concept of semi conservative (with respect to Messelson and Stahl experiment and Taylor et.al experiment on Vicia faba using radiolabelled thymidine) and semi-discontinuous replication, (leading and lagging strands), okazaki fragments.*

*RNA – definition, various types of RNAs such as mRNA, tRNA (Clover leaf model with diagram; brief introduction to L-shaped model), rRNA their structure and functions.*

*Techniques of nucleic acid estimation – colorimetry and UV-visible spectrophotometry.*

- (ii) Protein Synthesis: synthesis of different RNAs, and the complete mechanism of polypeptide chain formation.

*Concept of central dogma.*

*From genes to proteins:*

(a) *Concept of transcriptional unit, promoter, structural and terminator region; concept of split gene - intron and exon; monocistronic and polycistronic RNA, hnRNA;*

(b) *Transcription – explanation of the complete process including enzymes involved in the process; Post-transcriptional changes and their significance in eukaryotes – polyadenylation, capping and RNA splicing;*

(c) *Concept of reverse transcription;*

(d) *Genetic code – properties of genetic code, start and stop codons, anticodons.*

(e) *The translation of RNA to protein – complete mechanism of chain initiation, elongation and termination, the role of tRNA, mRNA and rRNA in protein synthesis. (Post translational changes not included).*

- (iii) Gene regulation in prokaryotes

*Operon concept – lac operon and trp operon.*

#### 2. Genetic Engineering

- (i) Introduction to gene cloning and genetic engineering: concept of cloning and vectors.

*Tools of recombinant DNA technology, types of restriction endonucleases and other enzymes used in gene cloning; techniques involved in extraction and purification of DNA from bacterial, plant and animal cells.*

*Selection of host cells: eukaryotic and prokaryotic.*

*Vectors: Characteristics and types such as plasmids -pBR322, pUC (in pBR322- presence of two antibiotic resistant genes and in pUCpresence of lac Z gene to be taught), cosmids, phages (M13 and  $\lambda$ ), YACs, BACs (to be taught with reference to stability and their carrying capacity), animal and plant viruses (CaMV, retrovirus, SV40 – only names of viruses, no details).*

*Transfer of recombinants into host cells –*

- (a) *Vectorless methods - basic concept of transformation, transfection, electroporation, liposome mediated gene transfer, microinjection, biolistic*
- (b) *Vector-mediated method - Agrobacterium tumefaciens induced gene transfer.*

*Methods of identification of recombinants-Direct selection (green fluorescent selection) and Insertional inactivation (Blue-white selection, antibiotic resistance).*

*A basic understanding of DNA libraries – construction of genomic and cDNA libraries.*

*Construction of a recombinant DNA molecule.*

- (ii) **Innovations in Biotechnology:** produced by using modern biotechnological tools, (select examples of products already available)
  - (a) *Plants: Production of Flavr Savr tomatoes, Bt-crops and Golden rice.*
  - (b) *Healthcare: Production of recombinant hepatitis-B vaccine, Humulin, interferon and edible vaccines.*
  - (c) *Animal: Dolly the cloned sheep, Sources and characteristics of stem cells and their applications.*
  - (d) *Environmental biotechnology: bioremediation using oil-eating bacteria as an example.*
  - (e) *Industrial biotechnology: applications of industrial enzymes – rennet, subtilisin, amylase, papain.*

- (iii) **Gene analysis techniques:** various techniques involved in recombinant DNA technology.

*DNA probes – definition and use.*

*Low resolution mapping techniques: gel electrophoresis, southern blotting (details of the technique to be taught), western and northern blotting (a brief idea and their uses).*

*High resolution techniques: DNA sequencing- sequencing by chain termination, automated DNA sequencing. Site directed mutagenesis.*

*DNA amplification by Polymerase chain reaction (PCR)– applications of PCR, steps and application of DNA profiling or DNA finger printing.*

### **3. Cell culture technology**

A brief idea of tools and techniques involved in cell culture technology and their applications in microbial, plant tissue and animal cell cultures respectively.

- (i) **General tools and techniques used in cell culture technology**
  - (a) *Instruments - centrifuge, LAF hood and biosafety cabinets, pH meter, autoclave, vortex mixer, hot air oven, magnetic stirrer, weighing balance, micro filtration unit, incubator, CO<sub>2</sub> incubator, inverted microscope, bioreactor (diagram, its components and their function)-stirred tank and sparged type (brief idea only), use of T flasks to propagate animal cells.*

**Only uses of the above instruments to be studied.**
  - (b) *Sterilization techniques for culture room, apparatus, transfer area, media, vitamins, and living material;*
  - (c) *Cryopreservation (need and steps).*
  - (d) *Cell counting (direct counting by haemocytometer), cell viability by Evan's blue stain and cell sorting (FACS only)*

- (e) *Types of media (synthetic /defined, semi-synthetic/differential, complex/natural)*

*Preparation of media: microbial media-LB agar and LB broth; Plant media-MS and White's media; Animal media-RPMI, DMEM and FBS - brief idea only. (includes inorganic and organic macronutrients and micronutrients, antibiotics, growth regulators for plants: auxins and cytokinins).*

*Importance of pH and solidifying agents.*

- (ii) Microbial culture and its application.

*Fermentation process and growth kinetics-batch culture, fed batch culture, continuous culture (with the help of graphs only): Definition of turbidostat and chemostat: Products and application-SCP (definition and use), industrial enzyme-subtilisin (source and its use).*

- (iii) Plant tissue culture and its application.

*Isolation of single cell by mechanical and enzymatic methods, synchronisation of cell culture by chemical methods like starvation, inhibition and mitotic arrest.*

*Cellular totipotency-definition of cellular differentiation, de-differentiation, re-differentiation. Application of plant cell culture technology (**methodology not required, only brief idea needed**):*

- (a) *Haploid production-androgenesis and gynogenesis and their significance.*  
 (b) *Triploid production-understanding and need for triploid production and its application (seedless crops).*  
 (c) *In-vitro pollination- concept and its application.*  
 (d) *Zygotic embryo culture- concept and its application, Embryo rescue (brief idea only).*  
 (e) *Somatic hybridisation-protoplast fusion (Pomato).*  
 (f) *Micropropagation and its significance.*  
 (g) *Developing virus free plants and synthetic seeds.*

- (h) *Biodegradable plastics (concept of PHB).*

- (iv) Animal cell culture and its application.

*Primary cell culture with mechanical and enzymatic disaggregation and its drawbacks; Types of cell-lines: finite, continuous, adherent and suspension; scale up-mono layer by Roller bottle, application of animal cell culture-tissue, hybridoma technology, tissue engineering (definition only).*

#### 4. Bioinformatics

- (i) Introduction to bioinformatics; global bioinformatics databases and data retrieval tools; genomics, different types of sequences, types of sequence analysis.

*Introduction to bioinformatics: definition and need.*

*An introduction to global bioinformatics databases (nucleotide and protein databases). Information sources such as EMBL, NCBI, DDBJ, SWISSPROT, GenBank, GENSCAN.*

*Data retrieval tools- ENTREZ, Taxonomy Browser.*

- (ii) Genomics: Definition, introduction, tools used in Genomics and its applications.

*Definition of genomics. Types of genomics-structural and functional. Basic criteria in selecting the organism for its genome sequencing. Different types of sequences – cDNA, genomic DNA, ESTs (Expressed Sequence Tags) and STSs (Sequence Tagged Sites) and the different softwares (example gene scan).*

*Types of sequence analysis by using BLAST and FASTA –global, local, pair wise and multiple.*

*Human Genome Project - its objectives, the countries involved, its achievements and significance.*

*DNA microarray technology – definition and application only.*

*Concept of Single Nucleotide Polymorphisms (SNPs).*

- (iii) Proteomics: definition, introduction and databases.

*Types of Proteomics – structural, functional and expression; Important protein databases available for the public on the internet like PDB (Protein Data Bank), PIR (Protein Identification Resources).*

## PAPER II

### PRACTICAL WORK – 15 marks

Candidates are required to complete the following experiments.

1. Paper Chromatography – separation of photosynthetic pigments

*Take any leaf. Extract chlorophyll in 80% acetone. Take a strip of paper or prepare a thin layer of silica gel on a slide. Load chlorophyll extract at one end of the paper/gel. Keep paper or gel in the rising medium in test tube or jar for about 30 minutes. The rising medium should have methanol/ acetic acid, n-butanol or benzene. The rising fluid should always be at the bottom below the point of loading of chlorophylls. After 30 minutes, three spots: yellow, bluish green and light green will be observed corresponding to carotenes, chlorophyll A & chlorophyll B.*

2. Preparation of buffers – phosphate, acetate and borate buffers

*This experiment should be done to make the basics clear to the students. Basic calculation for buffer preparation should be known. The approach should be to utilize easily available chemicals at reasonable costs. Phosphate, borate and acetate buffers can give the range of pH 4 - pH 9.2*

3. Preparation of culture media

*(i) Bacterial culture Media - Luria Bertani (L.B.) media - Peptone/ Tryptone, yeast extract and NaCl. (Nutrient broth / Nutrient Agar).*

*(ii) Plant Tissue culture medium (Sugars + Coconut milk + Agar Agar).*

4. Sterilization of culture medium and other materials.

*(i) Dry Physical method – heat or radiation.*

*(ii) Wet Physical methods – steam sterilization.*

*(iii) Chemical Sterilization/ Surface sterilization Disinfection with 70% alcohol and Sodium hypochlorite solution carbolic acid*

5. Preparation of various forms of culture media – Petri plate, slant and suspension.

*Luria Bertani (L.B) media to be prepared, autoclaved and cooled to 60 degrees C. To prepare nutrient plates the media is poured into presterilized petri-dishes under a LAF. To prepare slants the media is poured into several*

*test tubes, plugged and kept in a tilted position (at an angle of 45°) until it sets.*

6. Inoculation and incubation of *Lactobacillus* on the culture medium in the Petri plate.

*Use of inoculation loop or inoculation needle for the purpose.*

7. Identification of bacteria by Gram +ve and Gram –ve (from curd /saliva and/or soil solution)

*(i) Prepare a bacterial smear on a slide (ii) Stain with crystal violet stain. (iii) Rinse with water. (iv) Add a few drops of iodine solution. (v) Add few drops of 90 % ethanol (vi) Counterstain with safranin solution (vii) Observe the red and blue colonies under the microscope*

8. Action of enzymes on starch under: (a) variable temperature (b) variable substrate concentration – plotting of  $K_m$  value by graph

*(i) Soluble starch solution (0.5% - 1%) to be prepared. Test with iodine. Collect saliva, dilute 1: 5, add 1 ml of saliva to 10 ml of starch solution. Incubate for 15 minutes. Again test for presence of starch with iodine. Also test for the presence of reducing sugars in solution. Repeat the same process at the variable volumes of starch*

*(ii) To study the effect of variable temperature on the activity of the enzyme salivary amylase.*

9. Isolation of DNA from plants

*Take half a ripe and peeled banana into a beaker and add 50 ml of extraction fluid (1.5gm table salt +10 ml liquid detergent +90 ml distilled water). Place the beaker in a water bath set at 60 degrees C for 15 minutes. Stir gently with a glass rod. Filter 5ml of cooled content into a clean test tube and add 5ml of cold 90% ethanol. DNA molecules separate out and appear as white fibres. [DNA can also be extracted from pea seeds and soaked wheat grains]*

10. DNA estimation by colorimeter by DPA method.

11. Protein estimation by colour reaction – Bradford test.

*Bradford's Assay is a Dye binding assay based on the differential change of colour of a dye in response to various concentrations of proteins. Bradford's assay can be performed for qualitative as well as quantitative assessment of proteins in a sample.*

*Dilute 1 volume of Bradford's dye with 4 volumes of distilled water. Filter the dye through Whatman filter paper and store at room*

temperature in a brown glass bottle. Take different aliquots of standard Bovine Serum Albumin (BSA solution), for example (0.2, 0.4, 0.6, 0.8 and 1.0 ml) in different test tubes. Make up the volume to 1ml with distilled water. To each tube add 2ml of Bradford's dye. Extent of colour development can be made by rough estimate using + signs to show the concentration of protein in the sample. Alternatively, OD can be read using colorimeter or spectrophotometer. Take the unknown sample to be estimated and perform the experiment. Similarly read the OD and note the corresponding concentration of protein in it using the graph.

12. Cell viability test by Evan's blue dye.
13. Isolation of milk protein – wet weight and dry weight.  
*Milk proteins are isolated by adding 0.4 N HCl into the milk sample. Casein start coagulating at its isoelectric point (i.e. at pH 4.6). The precipitate is filtered and weighed to quantify the protein present.*
14. Chromatography to find adulteration in spices by using mixer of turmeric and metanil yellow.
15. Demonstration of cell counting by haemocytometer by using diluted blood.
16. Experiment to show the process of saponification.

## PROJECT WORK AND PRACTICAL FILE

– 15 Marks

### Project Work – 10 Marks

The Project Work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

Candidates are to creatively execute **one** project / assignment on an aspect of Biotechnology.

Teachers may assign or students may choose any one project of their choice. The report should be kept simple, but neat and elegant.

A list of suggested projects is as follows:

1. Effluent analysis.
2. A study of the technological details of malt preparation.
3. A study of the technological details of the brewing industry.
4. A study of the organisation of a fermenter.
5. Technological analysis of the process of drug development, drug designing and drug targeting.
6. A study of the technological details of vaccine development.
7. Diagnosis of diseases by modern techniques like ELISA, RIA and Antibody targeting.
8. DNA finger-printing.
9. DNA foot-printing.
10. Microbiological contaminants in food and food products.
11. Isolation of microbes from air, water and soil.
12. Methods of identifying microbes (various staining techniques and biochemical reactions).
13. Tissue Culture and its applications.
14. Stem Cell Technology
15. Nanotechnology
16. Bioinformatics
17. Genetic Engineering
18. Cloning
19. Instrumentation in biotechnology
20. Forensic Biotechnology
21. Ethical, Legal and Social Issues (ELSI) related to Biotechnology/ GMOs
22. Biopiracy- Case Studies

### Practical File – 5 Marks

The Visiting Examiner is required to assess students on the basis of the practical file maintained by them during the academic year.

### Suggested Evaluation Criteria for Project Work:

#### Format of the Project:

- Content
- Introduction
- Presentation (graphs, tables, charts, newspaper cuttings, diagrams, photographs, statistical analysis if relevant)
- Conclusion/ Summary
- Bibliography

## LIST OF EQUIPMENT FOR BIOTECHNOLOGY PRACTICALS FOR CLASSES XI & XII

1. Table-top Centrifuge
2. Vortex - Mixer
3. Thermostatic water-bath
4. Spectrophotometer (UV visible range)/ Colorimeter
5. Refrigerator
6. Lactometer
7. pH meter
8. Hot air oven
9. Autoclave
10. Desiccators
11. Micro-filtration unit
12. Incubator
13. Magnetic stirrer with hot plate
14. Laminar flow cabinet
15. Weighing Balance (Electrical)
16. Hot plate
17. Binocular Microscope
18. Haemocytometer
19. Colony counter
20. Antiserum
21. Electrophoresis chamber
22. Micropipettes

## LIST OF ABBREVIATIONS TO BE STUDIED

1. BAC: Bacterial Artificial Chromosomes
2. BLAST: Basic Local Alignment Search Tool
3. CTAB: Cetyl Trimethyl Ammonium Bromide
4. DBM: Diazo-benzyl oxy-methyl paper
5. DDBJ: DNA Database/ Data Bank of Japan
6. ddNTP: Dideoxy Nucleoside triphosphate
7. DMEM: Dulbecco Modified Eagle Medium
8. EBI: European Bioinformatics Institute
9. EMBL: European Molecular Biology Laboratory
10. EST: Expressed Sequence Tag
11. FACS: Fluorescence Activated Cell Sorting
12. FASTA: Fast All
13. FBS: Foetal Bovine Serum
14. HEPA: High Energy Particulate Air
15. HGP: Human Genome Project
16. IBPGR: International Board of Plant Genetic Resources
17. ICGEB: International Centre for Genetic Engineering and Biotechnology
18. IFN: Interferon
19. LB medium: Luria and Bertani Medium
20. MS medium: Murashige and Skoog medium
21. NCBI: National Centre for Biotechnology Information
22. NHGRI: National Human Genome Research Institute
23. PAGE: Polyacrylamide Gel Electrophoresis
24. PCR: Polymerization Chain Reaction
25. PDB: Protein Database/ Data Bank
26. PHB: Poly 3-Hydroxyl Butyrate
27. PIR: Protein Information Resource
28. RFLP: Restriction Fragment Length Polymorphism
29. RNA: Ribonucleic acid
30. RPMI medium: Roswell Park Memorial Institute medium
31. SCP: Single Cell Protein
32. SDS – PAGE: Sodium Dodecyl Sulphate– Polyacrylamide Gel Electrophoresis
33. SNP: Single Nucleotide Polymorphism
34. SSBs: Single Stranded Binding Proteins
35. STS: Sequence Tagged Site
36. VNTR: Variable Number of Tandem Repeats
37. YAC: Yeast Artificial Chromosome