ENGLISH COMMUNICATIVE
Subject Code-101
Class-X (2026-27)

SECTION-WISE WEIGHTAGE

Section		Total Weightage
A	Reading Skills	**22**
B	Writing Skills	**22**
C	Grammar	**10**
D	Literature Textbook	**26**
	TOTAL	**80**

SECTION A: READING SKILLS 12+10=22 Marks

- The section will have two unseen passages with the maximum word limit of 750 words. The passages canhave continuous and non-continuous text inspired from the themes in prescribed books. Please refer to theMain Course Book (MCB) for types of non-continuous texts. (For example –Unit 1 has lists, tables, cues, message, telephone conversation etc.).
- Objective Type Questions (including Multiple Choice Questions), Very Short Answer Type Questions (oneword/ one phrase / one sentence) and Short Answer Type Questions (30-40 words each) will be asked to test interpretation, analysis, inference, evaluation and vocabulary in context.

SECTION B: WRITING SKILLS 22 Marks

This section will have a variety of short and long writing tasks.

- Application for leave/ change of subject /change of section/ bus-timings or similar topics in maximum 50 words **3 marks**
- Factual Description of a person/object in maximum 100 words **4 marks**
- One out of two formal letters, in maximum 120 words, thematically aligned to topics in MCB. **7 marks**
- One out of two articles based on verbal cues, in maximum 150 words, thematically aligned to MCB topics. **8 marks**

SECTION C: GRAMMAR **10 marks**

Grammar items will be taught and assessed over a period of time.

1. Tenses
2. Modals
3. Subject – Verb Concord
4. Reported speech
    - Commands and requests
    - Statements
    - Questions
5. Clauses
    - Noun clauses
    - Adverb clauses
    - Relative clauses
6. Determiners

The above items may be tested through test types as given below:

- Gap filling **3 marks**
- Editing or Omission **4 marks**
- Sentences Reordering or Sentence Transformation in context. **3 marks**

SECTION D: LITERATURE TEXTBOOK **26 Marks**

- Two out of three extracts from prose/poetry for reference to the context. Very Short Answer Questions will be asked to assess global comprehension, interpretation, inference and evaluation. **4x2=8 marks**
- Five Short Answer Type Questions out of six from the Literature Reader to test local and global comprehension of theme and ideas, analysis, evaluation and appreciation (30-40 words each) **5x2 = 10 marks**
- One out of two Long Answer Type Questions to assess how the values inherent in the text have been brought out. Creativity, evaluation and extrapolation beyond the text and across the texts will be assessed.This can also be a passage-based question taken from a situation/plot from the texts. (150 words**).** **8 marks**

Prescribed Books: Interact in English Series by CBSE (available on www.cbseacademic.nic.in)

- Main Course Book (Revised Edition)
- Literature Reader (Revised Edition)
- Workbook (Revised Edition)

NOTE: Teachers are suggested to:

i) encourage classroom interaction among peers, students and teachers through activities such as roleplay, group work etc.,

ii) reduce teacher-talk time and keep it to the minimum,

iii) take up questions for discussion to encourage pupils to participate and to marshal their ideas andexpress and defend their views.

English Communicative
Question Paper Design
CLASS X (2026-27)

TIME: 3 Hours		Max. Marks: 80
S.No	**Competencies**	**% Weightage**
1	**Demonstrative Knowledge + Understanding** (Knowledge based simple recall questions, to know specific facts, terms, concepts, principles or theories, identify, define, or recite, information, Comprehension –to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase information)	Up to 30%
2	**Conceptual Application** (Use abstract information in concrete situation, to apply knowledge to new situations;use given content to interpret a situation, provide an example or solve a problem)	Up to 35%
3	**Analysis, Evaluation and Creativity** Analysis & Synthesis- classify, compare, contrast, or differentiate between different pieces of information; organise and/or integrate unique pieces of information from a variety of sources.	Up to 35%
Total		**100%**

Assessment of Listening and Speaking Skills: Guidelines for the Assessment ofListening and Speaking Skills are given at Annexure I.

Annexure I

Guidelines for Assessment of Listening and Speaking Skills (ALS)

ALS is a component of the Subject Enrichment Activity under Internal Assessment. ALS must be seen as an integrated component of all four language skills. Suggested activities, therefore, take intoconsideration an integration of the four language skills but during assessment, emphasis will be given to speaking and listening, since reading and writing are already being assessed in the written exam.

Assessment of Listening and Speaking Skills: (5 Marks)

i. **Activities:**

- Subject teachers must refer to books prescribed in the syllabus.
- In addition to the above, teachers may plan their own activities and create their own material for assessing the listening and speaking skills.

ii. **Parameters for Assessment:** The listening and speaking skills are to be assessed on the following parameters:

a) Interactive competence (Initiation and turn taking, relevance to the topic)
b) Fluency (cohesion, coherence and speed of delivery)
c) Pronunciation
d) Language (grammar and vocabulary)

Suggestive Rubric

	1	2	3	4	5
Interaction	• Contributions are mainly unrelated to those of other speakers • Shows hardly anyinitiative in the development of conversation • Very limited interaction	• Contributions are often unrelated to those of the otherspeaker • Generally passive inthe development of conversation	• Develops interaction adequately, makes however minimal effort to initiate conversation • Needs constant prompting to take turns	• Interaction is adequately initiated and developed • Takes turn butneeds some prompting	• Initiates & logically develops simple conversation onfamiliar topics • Takes turns appropriately
Fluency & Coherence	• Noticeably long pauses; rate of speech is slow • Frequent repetition and/or self-correction this is all right in	• Usually fluent; produces simple speech fluently, but loses coherence in complex	• Is willing to speak at length, however repetition is noticeable • Hesitates	• Speaks without noticeable effort,with a little repetition • Demonstrat es	• Speaks fluently almost with no repetition & minimal hesitation Develops topicfully & coherently

	informal conversation • Links only basic sentences; breakdown of coherence evident.	communication • Often hesitates and/or resorts to slow speech • Topics partly developed; not always concluded logically	and/or self corrects; occasionally loses coherence •Topics developed, but usually not logically concluded	hesitation to findwords or use correct grammatical structures and/or self-correction • Topics not fully developed to merit.	
Pronunciation	• Frequent inaccurate pronunciation • Communication is severely affected	• Frequently unintelligible articulation • Frequent phonological errors • Major communication problems	• Largely correct pronunciation & clear articulation except occasional errors	• Mostly correct pronunciation & clear articulation • Is clearly understood mostof the time; very few phonological errors	• Pronounces correctly & articulates clearly • Is always comprehensible • uses appropriate intonation
Vocabulary & Grammar	• Demonstrates almost no flexibility, and mostly struggles for appropriate words • Many Grammatical errors impacting communication	• Is able to communicate on some of the topics, with limited vocabulary. • Frequent errors, but self-corrects	• Is able to communicate on most of the topics, with limited vocabulary. • A few grammatical errors	• Is able to communicate on most of thetopics with appropriate vocabulary • Minor errors that do not hamper communication	• Is able to communicate on most of thetopics using awide range of appropriate vocabulary, using new words and expressions • No grammatical errors

iii. Schedule:

- The practice of listening and speaking skills should be done throughout the academic year.
- The final assessment of the skills is to be done as per the schedule of the school.

द्वितीय भाषा के रूप में हिंदी

विषय कोड - 085

कक्षा - 10वीं (2026-27)

राष्ट्रीय शिक्षा नीति 2020 तथा केंद्रीय माध्यमिक शिक्षा बोर्ड द्वारा समय-समय पर दक्षता आधारित शिक्षा, कला समेकित अधिगम, अनुभवात्मक अधिगम को अपनाने की प्रेरणा दी गई है, जो शिक्षार्थियों की प्रतिभा को उजागर करने, खेल-खेल में सीखने पर बल देने, आनंदपूर्ण ज्ञानार्जन और विद्यार्जन के विविध तरीकों को अपनाने तथा अनुभव के द्वारा सीखने पर बल देती है।

दक्षता आधारित शिक्षा से तात्पर्य है सीखने और मूल्यांकन करने का एक ऐसा दृष्टिकोण, जो शिक्षार्थी के सीखने के प्रतिफल और विषय में विशेष दक्षता को प्राप्त करने पर बल देता है। दक्षता वह क्षमता, कौशल, ज्ञान और दृष्टिकोण है, जो व्यक्ति को वास्तविक जीवन में कार्य करने में सहायता करती है। इससे शिक्षार्थी यह सीख सकते हैं कि ज्ञान और कौशल को किस प्रकार प्राप्त किया जाए तथा उन्हें वास्तविक जीवन की समस्याओं पर कैसे लागू किया जाए। जीवनोपयोगी बनाना तथा वास्तविक जीवन के अनुभवों से पाठ को समृद्ध करना ही दक्षता आधारित शिक्षा है। इसके लिए उच्च स्तरीय चिंतन कौशल पर विशेष बल देने की आवश्यकता है।

कला समेकित अधिगम को शिक्षण अधिगम प्रक्रिया में सुनिश्चित करना अत्यधिक आवश्यक है। कला के संसार में कल्पना की एक अलग ही उड़ान होती है। कला एक व्यक्ति की रचनात्मक अभिव्यक्ति है। कला समेकित अधिगम से तात्पर्य है- कला के विविध रूपों संगीत, नृत्य, नाटक, कविता, रंगशाला, यात्रा, मूर्तिकला, आभूषण बनाना, गीत लिखना, नुक्कड़ नाटक, कोलाज, पोस्टर, कला प्रदर्शनी को शिक्षण अधिगम की प्रक्रिया का अभिन्न हिस्सा बनाना। किसी विषय को आरंभ करने के लिए आइस ब्रेकिंग गतिविधि के रूप में तथा सामंजस्यपूर्ण समझ पैदा करने के लिए अंतरविषयक या बहुविषयक परियोजनाओं के रूप में कला समेकित अधिगम का प्रयोग किया जाना चाहिए। इससे पाठ अधिक रोचक एवं ग्राह्य हो जाएगा।

अनुभवात्मक अधिगम या आनुभविक ज्ञानार्जन का उद्देश्य शैक्षिक वातावरण को शिक्षार्थी केंद्रित बनाने के साथ-साथ स्वयं मूल्यांकन करने, आलोचनात्मक रूप से सोचने, निर्णय लेने तथा ज्ञान का निर्माण कर उसमें पारंगत होने से है। यहाँ शिक्षक की भूमिका सुविधा प्रदाता व प्रेक्षक की रहती है। ज्ञानार्जन आनुभाविक ज्ञानार्जन, सहयोगात्मक तथा स्वतंत्र रूप से होता है और यह शिक्षार्थियों को एक साथ कार्य करने तथा स्वयं के अनुभव द्वारा सीखने पर बल देता है। यह सिद्धांत और व्यवहार के बीच की दूरी को कम करता है।

भारत एक बहुभाषी देश है जिसमें बहुत सी क्षेत्रीय भाषाएँ रची बसी है। भाषिक और सांस्कृतिक दृष्टि से भिन्न होने के बावजूद भारतीय परंपरा में बहुत कुछ ऐसा है जो एक दूसरे को जोड़ता है। यही कारण है कि मातृभाषा के रूप में अलग भाषा को पढ़ने वाला विद्यार्थी जब दूसरी भाषा के रूप में हिंदी का चुनाव करता है तो उसके पास अभिव्यक्ति का एक रढ़ आधार पहली भाषा के रूप में पहले से ही मौजूद होता है। इसलिए छठी से आठवीं कक्षा में सीखी हुई हिंदी का विकास भी वह तेजी से करने लगता है। आठवीं कक्षा तक वह हिंदी भाषा में सुनने, पढ़ने, लिखने और कुछ-कुछ बोलने का अभ्यास कर चुका होता है। हिंदी की बात पत्रिकाएँ और छिटपुट रचनाएँ पढ़ना भी अब उसे आ गया है। इसलिए जब वह नवीं एवं दसवीं कक्षा में हिंदी पढ़ेगा तो जहाँ एक ओर हिंदी भाषा के माध्यम से सारे देश से जुड़ेगा वहीं दूसरी ओर अपने क्षेत्र और परिवेश को हिंदी भाषा के माध्यम से जानने की कोशिश भी करेगा, क्योंकि किशोरक्य के इन बच्चों के मानसिक धरातल का विकास विश्व सतर तक पहुँच चुका होता है।

शिक्षण उद्देश्य

- दैनिक जीवन में हिंदी में समझने-बोलने के साथ-साथ लिखने की क्षमता का विकास करना।
- हिंदी के किशोर-साहित्य, अखबार व पत्रिकाओं को पढ़कर समझ पाना और उसका आनंद उठाने की क्षमता का विकास करना।
- औपचारिक विषयों और संदर्भों में बातचीत में भाग ले पाने की क्षमता का विकास करना।
- हिंदी के ज़रिए अपने अनुभव संसार को लिखकर सहज अभिव्यक्ति कर पाने में सक्षम बनाना।
- संचार के विभिन्न माध्यमों (प्रिंट और इलेक्ट्रॉनिक) में प्रयुक्त हिंदी के विभिन्न रूपों को समझने की योग्यता का विकास करना।
- कक्षा में बहुभाषिक, बहुसांस्कृतिक संदर्भों के प्रति संवेदनशील सकारात्मक सोच बनाना।
- अपनी मातृभाषा और परिवेशगत भाषा को साथ रखकर हिंदी की संरचनाओं की समझ बनाना।
- सामाजिक मुद्दों पर समझ बनाना। (जाति, लिंग तथा आर्थिक विषमता)
- कविता, कहानी तथा घटनाओं को रोचक ढंग से लिखना ।
- भाषा एवं साहित्य को समझने एवं आत्मसात करने की दक्षता का विकास।

शिक्षण युक्तियाँ

- द्वितीय भाषा के रूप में पढ़ाई जा रही हिंदी भाषा का स्तर ऐसा होना चाहिए कि उसकी गति धीरे-धीरे बढ़ सके, इसके लिए हिंदी अध्यापकों को बड़े धीरज से अपने अध्यापन कार्यक्रमों को नियोजित करना होगा। किसी भी द्वितीय भाषा में निपुणता प्राप्त करने-कराने का एक ही उपाय है-उस भाषा का लगातार रोचक अभ्यास करना-कराना। ये अभ्यास जितने अधिक रोचक, सक्रिय एवं प्रासंगिक होंगे विद्यार्थियों की भाषिक उपलब्धि भी उतनी ही तेज़ी से हो सकेगी। मुखर भाषिक अभ्यास के लिए वार्तालाप, रोचक कहानी सुनना-सुनाना, घटना-वर्णन, चित्र-वर्णन, संवाद, वाद-विवाद, अभिनय, भाषण प्रतियोगिताएँ, कविता पाठ और अंत्याक्षरी जैसी गतिविधियों का सहारा लिया जा सकता है।
- **काव्य भाषा के मर्म** से विद्यार्थी का परिचय कराने के लिए ज़रूरी होगा कि किताबों में आए काव्यांशों की लयबद्ध प्रस्तुतियों के ऑडियो-वीडियो कैसेट तैयार किए जाएँ। अगर आसानी से कोई **गायक/गायिका** मिले तो कक्षा में मध्यकालीन साहित्य के अध्यापन-शिक्षण में उससे मदद ली जानी चाहिए।
- एनसीईआरटी द्वारा तैयार किए गए **अधिगम प्रतिफल** /सीखने-सिखाने की प्रक्रिया जो इस पाठ्यचर्या के साथ संलग्नक के रूप में उपलब्ध है, को शिक्षक द्वारा क्षमता आधारित शिक्षा का लक्ष्य प्राप्त करने के लिये अनिवार्य रूप से इस्तेमाल करने की आवश्यकता है।
- मानव संसाधन विकास मंत्रालय के विभिन्न संगठनों तथा स्वतंत्र निर्माताओं द्वारा उपलब्ध कराए गए अन्य कार्यक्रम/ई-सामग्री/ वृत्तचित्रों और सिनेमा को शिक्षण-सामग्री के तौर पर इस्तेमाल करने की ज़रूरत है। इनके प्रदर्शन के क्रम में इन पर लगातार बातचीत के ज़रिए **सिनेमा के माध्यम से भाषा के प्रयोग** की विशिष्टता की पहचान कराई जा सकती है और हिंदी की अलग-अलग छटा दिखाई जा सकती है।
- कक्षा में सिर्फ़ एक पाठ्यपुस्तक की उपस्थिति से बेहतर होगा कि शिक्षक के हाथ में विभिन्न प्रकार की पाठ्यसामग्री को विद्यार्थी देखें और कक्षा में अलग-अलग मौकों पर शिक्षक उनका इस्तेमाल कर सकें।

- भाषा लगातार ग्रहण करने की क्रिया में बनती है, इसे प्रदर्शित करने का एक तरीका यह भी है कि शिक्षक खुद यह सिखा सकें कि वे भी **शब्दकोश, साहित्यकोश, संदर्भग्रंथ** की लगातार मदद ले रहे हैं। इससे विद्यार्थियों में इनके इस्तेमाल करने को लेकर तत्परता बढ़ेगी। अनुमान के आधार पर निकटतम अर्थ तक पहुँचकर संतुष्ट होने की जगह वे सटीक अर्थ की खोज करने के लिए प्रेरित होंगे। इससे शब्दों की अलग-अलग रंगत का पता चलेगा, वे शब्दों के बारीक अंतर के प्रति और सजग हो पाएँगे।
- भिन्न क्षमता वाले विद्यार्थियों के लिए उपयुक्त शिक्षण-सामग्री का इस्तेमाल किया जाए तथा किसी भी प्रकार से उन्हें अन्य विद्यार्थियों से कमतर या अलग न समझा जाए।
- कक्षा में अध्यापन को हर प्रकार की विविधताओं (लिंग, धर्म, जाति, वर्ग, भाषा आदि) के प्रति सकारात्मक और संवेदनशील वातावरण निर्मित करना चाहिए।

श्रवण (सुनने) और वाचन (बोलने) की योग्यताएँ

- प्रवाह के साथ बोली जाती हुई हिंदी को अर्थबोध के साथ समझना।
- हिंदी शब्दों का उचित उच्चारण करना तथा हिंदी के स्वाभाविक अनुतान का प्रयोग करना।
- सामान्य विषयों पर बातचीत करना और परिचर्चा में भाग लेना।
- हिंदी कविताओं को उचित लय, आरोह-अवरोह और भाव के साथ पढ़ना।
- सरल विषयों पर कुछ तैयारी के साथ दो-चार मिनट का भाषण देना।
- हिंदी में स्वागत करना, परिचय और धन्यवाद देना।
- अभिनय में भाग लेना।

श्रवण तथा वाचन परीक्षा हेतु दिशा-निर्देश

- **श्रवण (सुनना) (2.5 अंक)**: वर्णित या पठित सामग्री को सुनकर अर्थग्रहण करना, वार्तालाप करना, वाद-विवाद, भाषण, कविता पाठ आदि को सुनकर समझना, विश्लेषण करना, मूल्यांकन करना और तद्नुसार अभिव्यक्ति के ढंग को समझना।
- **वाचन (बोलना) (2.5 अंक)**: भाषण, सस्वर कविता-पाठ, वार्तालाप और उसकी औपचारिकता, कार्यक्रम-प्रस्तुति, कथा-कहानी अथवा घटना सुनाना, परिचय देना, भावानुकूल संवाद-वाचन।

श्रवण (सुनना) एवं वाचन (बोलना) कौशल:

- परीक्षक किसी प्रासंगिक विषय पर एक अनुच्छेद का स्पष्ट वाचन करेगा। अनुच्छेद तथ्यात्मक या सुझावात्मक हो सकता है। अनुच्छेद लगभग 120 शब्दों का होना चाहिए।

या

- परीक्षक 1-1.5 मिनट का श्रव्य अंश (ऑडियो क्लिप) सुनवाएगा। अंश रोचक होना चाहिए। कथ्य/ घटना पूर्ण एवं स्पष्ट होनी चाहिए। वाचक का उच्चारण शुद्ध, स्पष्ट एवं विराम चिह्नों के उचित प्रयोग सहित होना चाहिए।
- परीक्षार्थी ध्यानपूर्वक परीक्षक/ऑडियो क्लिप को सुनने के पश्चात परीक्षक द्वारा पूछे गए प्रश्नों का अपनी समझ से मौखिक अथवा कार्यपत्रक के माध्यम से उत्तर देंगे।

कौशलों के अंतरण का मूल्यांकन

(इस बात का निश्चय करना कि क्या विद्यार्थी में श्रवण और वाचन की निम्नलिखित योग्यताएँ हैं)

	श्रवण (सुनना)		वाचन (बोलना)
1	परिचित संदर्भों में प्रयुक्त शब्दों और पदों को समझने की सामान्य योग्यता है।	1	केवल अलग-अलग शब्दों और पदों के प्रयोग की योग्यता प्रदर्शित करता है।
2	छोटे सुसंबद्ध कथनों को परिचित संदर्भों में समझने की योग्यता है।	2	परिचित संदर्भों में शुद्धता से केवल छोटे संबद्ध कथनों का सीमित प्रयोग करता है।
3	परिचित या अपरिचित दोनों संदर्भों में कथित सूचना को स्पष्ट समझने की योग्यता है।	3	अपेक्षाकृत दीर्घ भाषण में जटिल कथनों के प्रयोग की योग्यता प्रदर्शित करता है।
4	दीर्घ कथनों को पर्याप्त शुद्धता से समझता है और निष्कर्ष निकाल सकता है।	4	अपरिचित स्थितियों में विचारों को तार्किक ढंग से संगठित कर धारा-प्रवाह रूप में प्रस्तुत करता है।
5	जटिल कथनों के विचार-बिंदुओं को समझने और विश्लेषित करने की योग्यता प्रदर्शित करने की क्षमता है।	5	उद्देश्य और श्रोता के लिए उपयुक्त शैली को अपना सकता है।

पठन कौशल

पढ़ने की योग्यताएँ

- हिंदी में कहानी, निबंध, यात्रा-वर्णन, जीवनी, पत्र, डायरी आदि को अर्थबोध के साथ पढ़ना।
- पाठ्यवस्तु के संबंध में विचार करना और अपना मत व्यक्त करना।
- संदर्भ साहित्य को पढ़कर अपने काम के लायक सूचना एकत्र करना।
- पठित सामग्री के विभिन्न अंशों का परस्पर संबंध समझना।
- पठित वस्तु का सारांश तैयार करना।
- भाषा, विचार एवं शैली की सराहना करना।
- साहित्य के प्रति अभिरुचि का विकास करना।

लिखने की योग्यताएँ

- लिखते हुए व्याकरण-सम्मत भाषा का प्रयोग करना।
- हिंदी के परिचित और अपरिचित शब्दों की सही वर्तनी लिखना।
- विराम चिह्नों का समुचित प्रयोग करना।
- लेखन के लिए सक्रिय (व्यवहारोपयोगी) शब्द भंडार की वृद्धि करना।
- प्रभावपूर्ण भाषा तथा लेखन-शैली का स्वाभाविक रूप से प्रयोग करना।
- उपयुक्त अनुच्छेदों में बाँटकर लिखना।

- प्रार्थना पत्र, निमंत्रण पत्र, बधाई पत्र, संवेदना पत्र, आदेश पत्र, ईमेल, एस.एम.एस आदि लिखना और विविध प्रपत्रों को भरना।
- विविध स्रोतों से आवश्यक सामग्री एकत्र कर एक अभीष्ट विषय पर अनुछेद लिखना।
- देखी हुई घटनाओं का वर्णन करना और उन पर अपनी प्रतिक्रिया प्रकट करना।
- पढ़ी हुई कहानी को संवाद में तथा संवाद को कहानी में परिवर्तित करना।
- समारोह और गोष्ठियों की सूचना और प्रतिवेदन तैयार करना।
- लिखने में सृजनात्मकता लाना।
- अनावश्यक काट-छाँट से बचते हुए सुपाठ्य लेखन कार्य करना
- दो भिन्न पाठों की पाठ्यवस्तु पर चिंतन करके उनके मध्य की संबद्धता (अंतर्संबंधों) पर अपने विचार अभिव्यक्त करने में सक्षम होना।
- रटे-रटाए वाक्यों के स्थान पर अभिव्यक्तिपरक/ स्थिति आधारित/ उच्च चिंतन क्षमता वाले प्रश्नों पर सहजता से अपने मौलिक विचार प्रकट करना।

रचनात्मक अभिव्यक्ति

अनुच्छेद लेखन

- **पूर्णता** – संबंधित विषय के सभी पक्षों को अनुच्छेद के सीमित आकार में संयोजित करना।
- **क्रमबद्धता**– विचारों को क्रमबद्ध एवं तर्कसंगत विधि से प्रकट करना।
- **विषय-केंद्रित** – प्रारंभ से अंत तक अनुच्छेद का एक सूत्र में बँधा होना।
- **सामासिकता** – अनावश्यक विस्तार न देकर सीमित शब्दों में यथासंभव विषय संबद्ध पूरी बात कहने का प्रयास करना।

पत्र लेखन

- अनौपचारिक पत्र द्वारा पारस्परिक संबंधों मैत्रीपूर्ण भावों को व्यक्त करने हेतु सरल, संक्षिप्त लेखन शैली का विकास।
- औपचारिक पत्रों द्वारा दैनंदिनी जीवन की विभिन्न स्थितियों में कार्य, व्यापार, संवाद, परामर्श, अनुरोध तथा सुझाव के लिए प्रभावी एवं स्पष्ट संप्रेषण क्षमता का विकास।
- सरल और बोलचाल की भाषा शैली, उपयुक्त, सटीक शब्दों के प्रयोग, सीधे-सादे ढंग से स्पष्ट और प्रत्यक्ष बात की प्रस्तुति।
- प्रारूप की आवश्यक औपचारिकताओं के साथ सुस्पष्ट, सुलझे और क्रमबद्ध विचार आवश्यक;तथ्य, संक्षिप्तता और संपूर्णता के साथ प्रभावी प्रस्तुति।

विज्ञापन लेखन

(विज्ञापित वस्तु / विषय को केंद्र में रखते हुए)

- विज्ञापित वस्तु के विशिष्ट गुणों का उल्लेख
- आकर्षक लेखन शैली
- प्रस्तुति में नयापन, वर्तमान से जुड़ाव तथा दूसरों से भिन्नता
- विज्ञापन में आवश्यकतानुसार नारे (स्लोगन) का उपयोग
- विज्ञापन लेखन में बॉक्स, चित्र अथवा रंग का उपयोग अनिवार्य नहीं है, किंतु समय होने पर प्रस्तुति को प्रभावी बनाने के लिए इनका उपयोग किया जा सकता है।

चित्र-वर्णन

(चित्र में दिखाई दे रहे दृश्य /घटना को कल्पनाशक्ति से अपने शब्दों में लिखना)

- परिवेश की समझ
- सूक्ष्म विवरणों पर ध्यान
- दृश्यानुकूल भाषा
- क्रमबद्धता और तारतम्यता
- प्रभावशाली अभिव्यक्ति

संवाद लेखन

(दी गई परिस्थितियों के आधार पर संवाद लेखन)

- सीमा के भीतर एक दूसरे से जुड़े सार्थक और उद्देश्यपूर्ण संवाद
- पात्रों के अनुकूल भाषा शैली
- कोष्ठक में वक्ता के हाव भाव का संकेत
- संवाद लेखन के अंत तक विषय मुद्दे पर वार्ता

सूचना लेखन

(औपचारिक शैली में व्यावहारिक जीवन से संबंधित विषयों पर आधारित सूचना लेखन)

- सरल एवं बोधगम्य भाषा
- विषय की स्पष्टता
- विषय से जुड़ी संपूर्ण जानकारी
- औपचारिक शिष्टाचार का निर्वाह

ई-मेल लेखन

(विविध विषयों पर आधारित औपचारिक ई-मेल लेखन)

- सरल, शिष्ट व बोधगम्य भाषा
- विषय से संबद्धता
- संक्षिप्त कलेवर, किंतु विषयगत संपूर्ण जानकारी
- व्यावहारिक/कार्यालयी शिष्टाचार व औपचारिकताओं का निर्वाह

लघुकथा लेखन

(दिए गए विषय/शीर्षक आदि के आधार पर रचनात्मक सोच के साथ लघुकथा लेखन)

- निरंतरता
- कथात्मकता
- प्रभावी संवाद/पात्रानुकूल संवाद
- रचनात्मकता, कल्पनाशक्ति का उपयोग
- जिज्ञासा/रोचकता
- उद्देश्य केंद्रीयता

हिंदी पाठ्यक्रम –ब

विषय कोड – 085

कक्षा 10वीं (2026-27)

परीक्षा हेतु पाठ्यक्रम विनिर्देशन

खंड		भारांक
क	अपठित बोध	14
ख	व्यावहारिक व्याकरण	16
ग	पाठ्यपुस्तक एवं पूरक पाठ्यपुस्तक	28
घ	रचनात्मक लेखन	22

- **भारांक- 80 (वार्षिक बोर्ड परीक्षा)+20 (आंतरिक परीक्षा)**

निर्धारित समय- 3 घंटे **भारांक-80**

वार्षिक बोर्ड परीक्षा हेतु भार विभाजन				
खंड – क (बहुविकल्पी प्रश्न)				
	विषयवस्तु		उप भार	कुल भार
1	अपठित गद्यांश पर बोध, चिंतन, विश्लेषण, सराहना आदि पर बहुविकल्पीय, अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न			14
	अ	दो अपठित गद्यांश लगभग 200 शब्दों के । एक अंकीय तीन बहुविकल्पी प्रश्न (1x3=3) पूछे जाएँगे अतिलघूत्तरात्मक एवं लघूत्तरात्मक प्रश्न (2×2=4) पूछे जाएँगे	7+7	
		खंड – ख (व्यावहारिक व्याकरण)		
2	व्याकरण के लिए निर्धारित विषयों पर विषयवस्तु का बोध, भाषिक बिंदु/ संरचना आदि पर अतिलघूत्तरात्मक/लघूत्तरात्मक प्रश्न। (1x16) (कुल 20 प्रश्न पूछे जाएँगे, जिनमें से केवल 16 प्रश्नों के उत्तर देने होंगे)			16
	1	पदबंध (1x4=4) (5 में से 4 प्रश्न करने होंगे)	4	
	2	रचना के आधार पर वाक्य रूपांतरण (1x4=4) (5 में से 4 प्रश्न करने होंगे)	4	
	3	समास (1x4=4) (5 में से 4 प्रश्न करने होंगे)	4	
	4	मुहावरे (1x4=4) (5 में से 4 प्रश्न करने होंगे)	4	
3	**खंड – ग (पाठ्यपुस्तक एवं पूरक पाठ्यपुस्तक)**			

	अ	**गद्य खंड (पाठ्यपुस्तक)**		11	
		1	स्पर्श (भाग-2) से निर्धारित पाठों में से गद्यांश के आधार पर विषयवस्तु का ज्ञान, बोध, अभिव्यक्ति आदि पर एक अंकीय पाँच **बहुविकल्पी** प्रश्न पूछे जाएँगे। (1x5)	5	
		2	स्पर्श (भाग-2) से निर्धारित पाठों में से विषयवस्तु का ज्ञान, बोध, अभिव्यक्ति आदि पर तीन प्रश्न पूछे जाएँगे।(विकल्प सहित- 25-30 शब्द-सीमा वाले 4 में से 3 प्रश्न करने होंगे) (2x3)	6	
	ब		**काव्य खंड (पाठ्यपुस्तक)**	11	
		1	स्पर्श (भाग-2) से निर्धारित कविताओं में से काव्यांश के आधार पर एक अंकीय पाँच **बहुविकल्पी** प्रश्न पूछे जाएँगे (1x5)	5	28
		2	स्पर्श (भाग-2) से निर्धारित कविताओं के आधार पर विद्यार्थियों का काव्यबोध परखने हेतु तीन प्रश्न पूछे जाएँगे। (विकल्प सहित-25-30 शब्द-सीमा वाले 4 में से 3 प्रश्न करने होंगे) (2x3)	6	
	स		**पूरक पाठ्यपुस्तक संचयन भाग – 2**	6	
			संचयन (भाग-2) से निर्धारित पाठों पर आधारित दो प्रश्न पूछे जाएँगे। (3x2) (विकल्प सहित-50-60 शब्द-सीमा वाले 3 में से 2 प्रश्न करने होंगे)	6	
	खंड – घ (रचनात्मक लेखन)				
	i	विभिन्न विषयों और संदर्भों पर विद्यार्थियों के तर्कसंगत विचार प्रकट करने की क्षमता को परखने के लिए संकेत-बिंदुओं पर आधारित समसामयिक एवं व्यावहारिक जीवन से जुड़े हुए तीन विषयों में से किसी एक विषय पर लगभग 120 शब्दों में अनुच्छेद लेखन (5×1)		5	22
	ii	अभिव्यक्ति की क्षमता पर केंद्रित औपचारिक विषयों में से किसी एक विषय पर लगभग 100 शब्दों में पत्र (विकल्प सहित) (5×1)		5	
	iii	व्यावहारिक जीवन से संबंधित विषयों पर आधारित लगभग 60 शब्दों में सूचना लेखन। (विकल्प सहित) (4×1)		4	
	iv	विषय से संबंधित लगभग 40 शब्दों के अंतर्गत विज्ञापन लेखन (विकल्प सहित) (3×1)		3	
	v	विविध विषयों पर आधारित लगभग 80 शब्दों में ई-मेल लेखन (5×1) अथवा		5	

		दिए गए विषय/शीर्षक आदि के आधार पर लगभग 100 शब्दों में लघुकथा लेखन (5×1)		
		कुल		**80**
		आंतरिक मूल्यांकन	**अंक**	20
	अ	**सामयिक आकलन**	5	
	ब	**बहुविध आकलन**	5	
	स	**पोर्टफ़ोलियो**	5	
	द	**श्रवण एवं वाचन**	5	
		कुल		**100**

निर्धारित पुस्तकें:

1. **स्पर्श, भाग–2,** एन.सी.ई.आर.टी., नई दिल्ली द्वारा प्रकाशित नवीनतम संस्करण
2. **संचयन, भाग–2,** एन.सी.ई.आर.टी., नई दिल्ली द्वारा प्रकाशित नवीनतम संस्करण

❖ नोट : निम्नलिखित पाठों से प्रश्न नहीं पूछे जाएँगे।

पाठ्य पुस्तक स्पर्श, भाग-2

बिहारी-दोहे (पूरा पाठ)

महादेवी वर्मा- मधुर-मधुर मेरे दीपक जल (पूरा पाठ)

अंतोन चेखव- गिरगिट (पूरा पाठ)

पूरक पुस्तक संचयन, भाग-2

पुस्तक में कोई परिवर्तन नहीं। कोई भी पाठ नहीं हटाया गया है।

कक्षा दसवीं हेतु प्रश्न पत्र का विस्तृत प्रारूप जानने के लिए कृपया बोर्ड द्वारा जारी आदर्श प्रश्न पत्र देखें।

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Mathematics
Subject Code – 041 & 241
Class – X (2026-27)

The Mathematics curriculum for the Secondary stage has been redesigned in alignment with the National Education Policy 2020 and the National Curriculum Framework for School Education (NCF – SE) 2023, prioritizing deep conceptual understanding and logical reasoning. The revised syllabus places strong emphasis on developing core mathematical competencies, including problem-solving, visualisation, mathematical modelling, mathematical communication, computational thinking, and data analytics. The syllabus integrate Indian Knowledge System with contemporary mathematical knowledge, highlighting the rich contributions of Indian mathematicians to foster a sense of pride and historical context. A deliberate shift from rote learning to competency-based education ensures that students build deep conceptual understanding and logical reasoning rather than mere procedural fluency. Greater emphasis has been laid on the integration of real-life applications and experiential learning, encouraging students to connect mathematical concepts with everyday situations and cross-disciplinary contexts. Greater emphasis has been laid on competency based learning outcomes encouraging students to connect mathematical concepts with everyday situations and inter-disciplinary contexts. Continuous and holistic assessment through projects, activities, and investigations forms an integral part of the learning process, moving beyond summative examinations.

At the secondary stage, the curriculum focuses on developing essential global mathematical competencies, including mathematical representation through quantities and relations, mathematical modelling and algorithm building, and effective mathematical communication. The study of the number system, algebra, geometry, mensuration, statistics and probability is designed to build a strong foundation for higher education while enhancing functional life skills. The curriculum thus aims to build rich mathematical learning frameworks not only for higher academic pursuits but also for the practical demands of life in a rapidly changing, data-driven world.

Objectives The broad objectives of teaching Mathematics at the secondary stage are to help the learners to:

- develop logical thinking, critical reasoning, and a structured approach to problem-solving;
- build the ability to recognise, analyse, and solve diverse problems with confidence and adaptability;
- communicate mathematical ideas effectively using appropriate language, symbols, and representations;
- appreciate the beauty, history, and real-life relevance of Mathematics as a discipline;

- connect mathematical concepts to fields such as Science, Technology, Engineering, and Economics;
- engage in both collaborative and independent mathematical exploration and learning;
- develop habits of precision, accuracy, and logical consistency in mathematical work;
- build confidence to explore, experiment, and grow in mathematical understanding without fear of failure.

COURSE STRUCTURE CLASS –X

Units	Unit Name	Marks
I	NUMBER SYSTEMS	06
II	ALGEBRA	20
III	COORDINATE GEOMETRY	06
IV	GEOMETRY	15
V	TRIGONOMETRY	12
VI	MENSURATION	10
VII	STATISTICS AND PROBABILITY	11
	TOTAL	**80**

S. No.	Content	Competencies	Explanation
	UNIT I: NUMBER SYSTEMS		
1.	**REAL NUMBERS** 1. Fundamental Theorem of Arithmetic - statements after reviewing work done earlier and after illustrating and motivating through examples 2. Proofs of irrationality of $\sqrt{2}, \sqrt{3}, \sqrt{5}$	• Develops understanding of numbers, including the set of real numbers and its properties. • Extends the understanding of powers (radical powers) and exponents. • Applies Fundamental Theorem of Arithmetic to solve problems related to real life contexts.	• Describes Fundamental Theorem of Arithmetic with examples • Prove algebraically the Irrationality of numbers like $\sqrt{2}, \sqrt{3}, \sqrt{5}, 3 + 2\sqrt{5}$ etc.
	UNIT II: ALGEBRA		
1.	**POLYNOMIALS** 1. Zeros of a polynomial 2. Relationship between zeros and coefficients of quadratic polynomials.	• develops a relationship between algebraic and graphical methods of finding the zeroes of a polynomial.	• Find the zeros of polynomial graphically and algebraically and verifying the relation between zeros and coefficients of quadratic polynomials.

2.	**PAIR OF LINEAR EQUATIONS IN TWO VARIABLES** 1. Pair of linear equations in two variables and graphical method of their solution, consistency/inconsistency. 2. Algebraic conditions for number of solutions. 3. Solution of a pair of linear equations in two variables algebraically - by substitution, by elimination. Simple situational problems.	• Describes plotting a pair of linear equations and graphically finding the solution. • Models and solves contextualised problems using equations (e.g., simultaneous linear equations in two variables).	• Find the solution of pair of linear equations in two variables graphically and algebraically (substitution and elimination method)
3.	**QUADRATIC EQUATIONS** 1. Standard form of a quadratic equation $ax^2 + bx + c = 0, (a \neq 0)$. 2. Solutions of quadratic equations (only real roots) by factorization, and by using quadratic formula. Relationship between discriminant and nature of roots. 3. Situational problems based on quadratic equations related to day-to-day activities to be incorporated	• demonstrates strategies of finding roots and determining the nature of roots of a quadratic equation.	• Solves quadratic equations using factorization and quadratic formula • Determines the nature of roots using discriminant • Formulates and solves problems based on real life context
4.	**ARITHMETIC PROGRESSIONS** 1. Motivation for studying Arithmetic Progression 2. Derivation of the nth term and sum of the first n terms of AP and their application in solving daily life problems.	• Develops strategies to apply the concept of A.P. to daily life situations.	• Applies concepts of AP to find the nth term and sum of n terms. • Application of AP in real life problems

UNIT III: COORDINATE GEOMETRY			
1.	**Coordinate Geometry** **1. Review:** Concepts of coordinate geometry. Distance formula. Section formula (internal division).	• Derives formulae to establish relations for geometrical shapes in the context of a coordinate plane, such as, finding the distance between two given points, to determine the coordinates of a point between any two given points.	• Solves problems using distance formula and section formula
UNIT IV: GEOMETRY			
1.	**TRIANGLES** Definitions, examples, counter examples of similar triangles. 1. (Prove) If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio. 2. State (without proof) If a line divides two sides of a triangle in the same ratio, the line is parallel to the third side. 3. State (without proof) If in two triangles, the corresponding angles are equal, their corresponding sides are proportional and the triangles are similar. 4. State (without proof) If the corresponding sides of two triangles are proportional, their corresponding angles are equal and the two triangles are similar. 5. State (without proof) If one angle of a triangle is equal to one angle of another triangle and the sides including these angles are proportional, the two triangles are similar.	• works out ways to differentiate between congruent and similar figures. • establishes properties for similarity of two triangles logically using different geometric criteria established earlier such as, Basic Proportionality Theorem, etc.	• Prove Basic Proportionality theorem and applying the theorem and its converse in solving questions • Prove similarity of triangles using different similarity criteria

2.	**CIRCLES** Tangent to a circle at point of contact. 1. (Prove) The tangent at any point of a circle is perpendicular to the radius through the point of contact. 2. (Prove) The lengths of tangents drawn from an external point to a circle are equal.	• derives proofs of theorems related to the tangents of circles.	• Prove the theorems based on the tangent to a circle. • Applies the concept of tangents of circle to solve various problems.
UNIT V: TRIGONOMETRY			
1.	**INTRODUCTION TO TRIGONOMETRY** 1. Trigonometric ratios of an acute angle of a right-angled triangle. Proof of their existence (well defined) 2. Motivate the ratios whichever are defined at $0°$ and $90°$. Values of the trigonometric ratios of $30°$, $45°$ and $60°$. 3. Relationships between the ratios.	• Understands the definitions of the basic trigonometric functions (including the introduction of the sine and cosine functions).	• Evaluates trigonometric ratios • Describes trigonometric ratios of standard angles and solving related expressions
2.	**TRIGONOMETRIC IDENTITIES** 1. Proof and applications of the identity $\sin^2 A + \cos^2 A = 1$. 2. Only simple identities to be given.	• Uses Trigonometric identities to solve problems.	• Proves trigonometric identities using $\sin^2 A + \cos^2 A = 1$ and other identities
3.	**HEIGHTS AND DISTANCES: Angle of elevation, Angle of Depression.** 1. Simple problems on heights and distances. Problems should not involve more than two right triangles. Angles of elevation / depression should be only 30°, 45°, and 60°.	• Applies Trigonometric ratios in solving problems in daily life contexts like finding heights of different structures or distance from them.	• Find heights and distances in real life word problems using trigonometric ratios

UNIT VI: MENSURATION			
1.	**AREAS RELATED TO CIRCLES** 1. Area of sectors and segments of a circle. 2. Problems based on areas and perimeter /circumference of the above said plane figures. (In calculating area of segment of a circle, problems should be restricted to central angle of 60°, 90° and 120° only.	• Derives and uses formulae to calculate areas of plane figures.	• Visualises and evaluates areas of sector and segment of a circle
2.	**SURFACE AREAS AND VOLUMES** 1. Surface areas and volumes of combinations of any two of the following: cubes, cuboids, spheres, hemispheres and right circular cylinders/cones.	• Visualises and uses mathematical thinking to discover formulae to calculate surface areas and volumes of solid objects (cubes, cuboids, spheres, hemispheres, right circular cylinders/cones, and their combinations).	• Evaluates the surface areas and volumes of combinations of solids by visualisation
UNIT VII: STATISTICS AND PROBABILITY			
1.	**STATISTICS** 1. Mean, median and mode of grouped data (bimodal situation to be avoided).	• calculates mean, median and mode for different sets of data related with real life contexts.	• Computes the mean, of a grouped frequency distribution using direct, assumed mean and step deviation method. • Computes the median and mode of grouped frequency distribution by algebraic method
2.	**PROBABILITY** 1. Classical definition of probability. 2. Simple problems on finding the probability of an event.	• Applies concepts from probability to solve problems on the likelihood of everyday events.	• Determines the probabilities in simple real-life problems

MATHEMATICS- STANDARD (Code – 041)

QUESTION PAPER DESIGN

CLASS – X (2026-27)

Time: 3 Hours **Max. Marks: 80**

S. No.	Typology of Questions	Total Marks	% Weightage (approx.)
1	**Remembering:** Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. **Understanding:** Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	43	54
2	**Applying:** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	19	24
3	**Analysing:** Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations **Evaluating:** Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. **Creating:** Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions	18	22
	Total	**80**	**100**

INTERNAL ASSESSMENT	**20 MARKS**
Pen Paper Test and Multiple Assessment (5+5)	10 Marks
Portfolio	05 Marks
Lab Practical (Lab activities to be done from the prescribed books)	05 Marks

MATHEMATICS-BASIC (Code – 241)

QUESTION PAPER DESIGN

CLASS – X (2026-27)

Time: 3Hours **Max. Marks: 80**

S. No.	Typology of Questions	Total Marks	% Weightage (approx.)
1	**Remembering:** Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers. **Understanding:** Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas	60	75
2	**Applying:** Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	12	15
3	**Analysing:** Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations **Evaluating:** Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. **Creating:** Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions	8	10
	Total	**80**	**100**

INTERNAL ASSESSMENT	**20 MARKS**
Pen Paper Test and Multiple Assessment (5+5)	10 Marks
Portfolio	05 Marks
Lab Practical (Lab activities to be done from the prescribed books)	05 Marks

PRESCRIBED BOOKS:

1. Mathematics - Textbook for class X - NCERT Publication
2. Guidelines for Mathematics Laboratory in Schools, class X - CBSE Publication
3. Laboratory Manual - Mathematics, secondary stage - NCERT Publication
4. Mathematics exemplar problems for class X, NCERT publication.

SCIENCE

Subject Code – 086

Class X (2026-27)

Introduction

Science is the study of the natural and physical world around us through a systematic process of observing, questioning, forming hypotheses, testing hypotheses through experiment, analysing evidence, and continuously revising our knowledge. It develops essential skills like curiosity, creativity, evidence-based thinking, and sound decision-making that help us lead rational and fulfilling lives. Learning Science provides valid knowledge about the world, and builds scientific values and capacities. It draws knowledge from Biology, Chemistry, Physics, Earth Science, Mathematics, Computational Sciences, and sometimes Social Science and Vocational Education to offer an interdisciplinary understanding of the role of science.

Science Education helps students to develop an understanding of the natural and physical world through systematic inquiry. Learning Science also develops important capacities, such as observation, questioning, analysis, inference, etc. This helps individuals to meaningfully participate in society and the world of work with a scientific temper, critical and evidence-based thinking, asking relevant questions, analysing practices and norms, and acting for necessary change.

Science Education aims to achieve:

- Scientific understanding of the natural and physical world;
- Capacities for scientific inquiry;
- Understanding the evolution of scientific knowledge;
- Interdisciplinary understanding between Science and other curricular areas;
- Understanding of the relationship between Science, Technology, and Society;
- Scientific temper, and
- Creativity.

Together, the NEP 2020 and NCF-SE 2023 envision science classrooms that encourage curiosity, creativity, collaboration and connection with the real world, ultimately nurturing not just future scientists, but responsible, informed and critically thinking citizens.

Learning standards (Curricular Goals and Competencies) describe what students should know, understand, and be able to do in Science. In Grades 9 – 10, Science is taught using an integrated approach that combines Biology, Chemistry, Physics, and Earth Science. This helps students understand the connections between disciplines and relate Science to their observations and experiences. At this stage, scientific inquiry skills are developed alongside conceptual understanding, with content selected both for disciplinary relevance and real-life usefulness. Students must deepen their understanding of the world, explore scientific questions through discussion and experimentation, and communicate their learning in various ways. It is important to note that the Curricular Goals are interdependent and not separate.

Learning standards are organised into four levels: broad curricular aims define the overall objectives for Science Learning by the end of each schooling stage; more specific Curricular Goals guide the design of the science curriculum for each stage and topic; Competencies

represent measurable scientific skills and knowledge-based on these goals, assessed at the end of each stage; and detailed Learning Outcomes (LOs) are granular milestones of learning and usually progress in a sequence leading to the attainment of a competency. These LOs enable teachers to plan their content, pedagogy, and assessments towards achieving specific competencies.

Curricular Goals (CGs) and Competencies (Cs)

CG 1 – Explores the world of matter, its interactions, and properties at the atomic level

C 1.1 – Describes classification of elements in the Periodic Table, and explains how compounds (including carbon compounds) are formed based on the atomic structure (Bohr's model) and properties (valency).

C 1.2 – Investigates the nature and properties of chemical substances (distillation, crystallisation, chromatography, centrifugation, types and properties of mixtures, solutions, colloids, and suspensions)

C 1.3 – Describes and represents chemical interactions and changes using symbols and chemical equations (acid and base, metal and non-metal, reversible and irreversible)

CG 2 – **Explores the physical world around them, and understands scientific principles and laws based on observations and analysis**

C 2.1 – Applies Newton's laws to explain the effect of forces (change in state of motion — displacement and direction, velocity and acceleration, uniform circular motion, acceleration due to gravity) and analyses graphical and mathematical representations of motion in one dimension

C 2.2 – Explains the relationship between mass and weight using universal law of gravitation, and connect it to the laws of motion

C 2.3 – Manipulates the position of object and properties of lenses (focus, centre of curvature) to observe image characteristics and correspondence with a ray diagram, and extends this understanding to a combination of lenses (telescope, microscope)

C 2.4 – Manipulates and analyses different characteristics of the circuit (current, voltage, resistance) and mathematises their relationship (Ohm's law), and applies it to everyday usage (electricity bill, short circuit, safety measures)

C 2.5 – Defines work in scientific terms, and represents the relationship between potential and kinetic energy (conservation of energy) in mathematical expressions

C 2.6 – Demonstrates the principle of mechanical advantage by constructing simple machines (system of levers and pulleys)

C 2.7 – Describes the origin and properties of sound (wavelength, frequency, amplitude) and differences in what we hear as it propagates through different instruments

C 2.8 – *Explores interconnected systems and phenomena that support and affect life on Earth (hydrosphere, biosphere, atmosphere, geosphere, cryosphere and their interrelationships, earth processes, hazards, etc.)

*Additional Competency for Earth Science

CG 3 – **Explores the structure and function of the living world at the cellular level**

C 3.1 – Explains the role of cellular components (nucleus, mitochondria, endoplasmic reticulum, vacuoles, chloroplast, cell wall), including the semi-permeability of cell membrane in making cell the structural basis of living organisms and functional basis of life processes

C 3.2 – Analyses similarities and differences in the life processes involved in nutrition (photosynthesis in plants; absorption of nutrients in fungi; digestion in animals), transport (transport of water in plants; circulation in animals), exchange of materials (respiration and excretion), and reproduction

C 3.3 – Describes the mechanisms of heredity (in terms of DNA, genes, chromosomes) and variation (as changes in the sequence of DNA)

CG 4 – **Explores interconnectedness between organisms and their environment**

C 4.1 – Applies the knowledge of cellular diversity in organisms along with the ecological role organisms play (autotrophic or heterotrophic nutrition) to classify them into five kingdoms

C 4.2 – Illustrates different levels of organisations of living organisms (from molecules to organisms)

C 4.3 – Analyses different levels of biological organisation from organisms to ecosystems and biomes along with interactions that take place at each level

C 4.4 – Analyses patterns of inheritance of traits in terms of Mendel's laws and its consequences at a population level (using models and/or simulations)

C 4.5 – Analyses evidences of biological evolution demonstrating the consequences of the process of natural selection in terms of changes — in allele frequency in population, structure, and function of organisms

CG 5 – **Draws linkages between scientific knowledge and knowledge across other curricular areas**

C 5.1 – Explores how literature and arts have influenced Science

C 5.2 – Examines a case study related to the use of Science in human life from the perspective of Social Sciences and Ethics (for example, Marie Curie, Jenner, treatment of patients with mental illnesses, the story of the atomic bomb, green revolution and GMOs, conservation of biodiversity)

C 5.3 – Applies scientific principles to explain phenomena in other subjects (sound pitch, octave, and amplitude in music; use of muscles in dance form and sports)

CG 6 – **Understands and appreciates the contribution of India through history, and the present time to the overall field of Science, including the disciplines that constitute it**

C 6.1 – Knows and explains the significant contributions of India to all matters (concepts, explanations, methods) that are studied within the curriculum in an integrated manner

CG 7 – **Develops awareness of the most current discoveries, ideas, and frontiers in all areas of scientific knowledge in order to appreciate that Science is ever evolving, and that there are still many unanswered questions**

C 7.1 – States concepts that represent the most current understanding of the matter being studied, ranging from mere familiarity to conceptual understanding of the matter as appropriate to the developmental stage of the students

C 7.2 – States questions related to matters in the curriculum for which current scientific understanding is well-recognised

CG 8 – **Explores the nature of Science by doing Science**

C 8.1 – Develops accurate and appropriate models (including geometric, mathematical, graphical) to represent real-life events and phenomena using scientific principles, and use these models to manipulate variables and predict results

C 8.2 – Designs and implements a plan for scientific inquiry (formulates hypotheses, makes predictions, identifies variables, accurately uses scientific instruments, represents data — primary and secondary — in multiple modes, draws inferences based on data, and understanding of scientific concepts, theories, laws and principles, and communicates findings using scientific terminology)

COURSE STRUCTURE
CLASS X (2026-27)
(Annual Examination)

Time: 03 Hours Marks: 80

Unit No.	Unit	Marks
I	Chemical Substances-Nature and Behaviour	25
II	World of Living	25
III	Natural Phenomena	12
IV	Effects of Current	13
V	Natural Resources	05
	Total	**80**
	Internal assessment	**20**
	Grand Total	**100**

Theme: Materials

Unit I: Chemical Substances - Nature and Behaviour

Chemical Reactions and Equations: Chemical reactions, Chemical equation, Balanced chemical equation, types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, endothermic exothermic reactions, oxidation and reduction.

The following topics are included in the syllabus but will be assessed only formatively to reinforce understanding without adding to summative assessments. The reduces academic stress while ensuring meaningful learning. Schools can integrate these with existing chapters as they align well. Relevant NCERT textual material is enclosed for reference.

Periodic Classification of Elements: Döbereiner's Triads, Newlands' Law of Octaves, Mendeléev's Periodic Table, Modern Periodic Table and the Modern, Metallic and Non-metallic Properties.

Acids, Bases and Salts: Acids and Bases – definitions in terms of furnishing of H^+ and OH^- ions, identification using indicators, chemical properties, examples and uses, neutralization, concept of pH scale (Definition relating to logarithm not required), importance

of pH in everyday life; preparation and uses of Sodium Hydroxide, Bleaching Powder, Baking soda, Washing soda and Plaster of Paris.

Metals and Non-metals: Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds; Basic metallurgical processes; Corrosion and its prevention.

Carbon and its Compounds: Covalent bonds – formation and properties of covalent compounds, Versatile nature of carbon, Hydrocarbons – saturated and unsaturated Homologous series. Nomenclature of alkanes, alkenes, alkyne and carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes). Chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and Ethanoic acid (only properties and uses), soaps and detergents.

Theme: The World of the Living

Unit II: World of Living

Life processes: 'Living Being'. Basic concept of nutrition, respiration, transport and excretion in plantsand animals.

Control and co-ordination in animals and plants: Tropic movements in plants; Introduction of plant hormones; Control and co-ordination in animals: Nervous system; Voluntary, involuntary and reflex action; Chemical co-ordination: animal hormones.

Reproduction: Reproduction in animals and plants (asexual and sexual) reproductive health - need and methods of family planning. Safe sex vs HIV/AIDS. Child bearing and women's health.

Heredity: Heredity; Mendel's contribution- Laws for inheritance of traits: Sex determination; brief introduction.

The following topics are included in the syllabus but will be assessed only formatively to reinforce understanding without adding to summative assessments. The reduces academic stress while ensuring meaningful learning. Schools can integrate these with existing chapters as they align well. Relevant NCERT textual material is enclosed for reference.

Evolution: Acquired and Inherited Traits, Speciation, Evolution and Classification, Tracing Evolutionary Relationships, Fossils, Evolution by Stages, Human Evolution

Theme: Natural Phenomena

Unit III: Natural Phenomena

Reflection of light by curved surfaces; Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (Derivation not required), magnification.

Refraction; Laws of refraction, refractive index.

Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivationnot required); Magnification. Power of a lens.

Functioning of a lens in human eye, defects of vision and their corrections, applications of spherical mirrors and lenses.

Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life (excluding colour of the sun at sunrise and sunset).

Theme: How Things Work

Unit IV: Effects of Current

Electric current, potential difference and electric current. Ohm's law; Resistance, Resistivity, Factors on which the resistance of a conductor depends. Series combination of resistors, parallel combination of resistors and its applications in daily life. Heating effect of electric current and its applications in daily life. Electric power, Interrelation between P, V, I and R.

Magnetic effects of current: Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule, Direct current. Alternating current: frequency of AC. Advantage of AC over DC. Domestic electric circuits.

The following topics are included in the syllabus but will be assessed only formatively to reinforce understanding without adding to summative assessments. The reduces academic stress while ensuring meaningful learning. Schools can integrate these with existing chapters as they align well. Relevant NCERT textual material is enclosed for reference

Motor, Electromagnetic Induction, Electric Generator

Theme: Natural Resources

Unit V: Natural Resources

Our environment: Eco-system, Environmental problems, Ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances.

Note for Teachers:

1. The topics Periodic Classification of Elements; Heredity and Evolution; and Electric Effects of Electric Current will not be assessed in the year-end examination.
2. Learners may be assigned to read these topics/chapter and encouraged to prepare a brief write up in their Portfolio. Teachers should provide joyful and experiential opportunities. This may be for Internal Assessment and credit may be given for Periodic Assessment/Portfolio.
3. The NCERT text books present information in boxes across the book. These help students to get conceptual clarity. However, the information in these boxes would not be assessed in the year-end examination.

PRACTICALS

Practical should be conducted alongside the concepts taught in theory classes.

LIST OF EXPERIMENTS

1. A. Finding the pH of the following samples by using pH paper/universal indicator: **Unit-I**

a) Dilute Hydrochloric Acid

b) Dilute NaOH solution

c) Dilute Ethanoic Acid solution

d) Lemon juice

e) Water

f) Dilute Hydrogen Carbonate solution

B. Studying the properties of acids and bases (HCl & NaOH) on the basis of their reaction with: **Unit-I**

a) Litmus solution (Blue/Red)
b) Zinc metal
c) Solid sodium carbonate

2. Performing and observing the following reactions and classifying them into: **Unit-I**

a) Combination reaction

b) Decomposition reaction

c) Displacement reaction

d) Double displacement reaction

- Action of water on quicklime
- Action of heat on ferrous sulphate crystals
- Iron nails kept in copper sulphate solution
- Reaction between sodium sulphate and barium chloride solutions

3. Observing the action of Zn, Fe, Cu and Al metals on the following salt solutions:

Unit-I

a) $ZnSO_4$ (aq)

b) $FeSO_4$ (aq)

c) $CuSO_4$ (aq)

d) $Al_2 (SO_4)_3$ (aq)

Arranging Zn, Fe, Cu and Al (metals) in the decreasing order of reactivity based on theabove result.

4. Studying the dependence of potential difference (V) across a resistor on the current (I) passing through it and determine its resistance. Also plotting a graph between V and I.

Unit-IV

5. Determination of the equivalent resistance of two resistors when connected in series and parallel. **Unit-IV**

6. Preparing a temporary mount of a leaf peel to show stomata. **Unit- II**

7. Experimentally show that carbon dioxide is given out during respiration. **Unit-II**

8. Study of the following properties of acetic acid (ethanoic acid): **Unit- I**

   a) Odour

   b) solubility in water

   c) effect on litmus

   d) reaction with Sodium Hydrogen Carbonate

9. Study of the comparative cleaning capacity of a sample of soap in soft and hard water. **Unit- I**

10. Determination of the focal length of: **Unit-III**

    a) Concave mirror

    b) Convex lens by obtaining the image of a distant object.

11. Tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. Measure the angle of incidence, angle of refraction, angle of emergence andinterpret the result. **Unit - III**

12. Studying (a) binary fission in *Amoeba,* and (b) budding in yeast and Hydra with the help of prepared slides. **Unit-II**

13. Tracing the path of the rays of light through a glass prism. **Unit-III**

14. Identification of the different parts of an embryo of a dicot seed (pea, gram or red kidney bean). **Unit-II**

PRESCRIBED BOOKS:

- Science-Text book for class X- NCERT Publication
- Assessment of Practical Skills in Science- Class X- CBSE Publication
- Laboratory Manual-Science-Class X, NCERT Publication
- Exemplar Problems Class X – NCERT Publication
- Reading Material – Science – Class X (2026-27) – CBSE

Question Paper Design (Theory)

Class X (2025-26)

Science (086)

Theory (80 marks)

Competencies	Total
Demonstrate Knowledge and Understanding	50 %
Application of Knowledge/Concepts	30 %
Formulate, Analyze, Evaluate and Create	20 %

Note:

- Typology of Questions: VSA including objective type questions, Assertion – Reasoning type questions; SA; LA; Source-based/ Case-based/ Passage-based/ Integrated assessment questions.
- An internal choice of approximately 33% would be provided.

Internal Assessment (20 Marks)

- **Periodic Assessment** - 05 marks + 05 marks
- **Subject Enrichment** (Practical Work) - 05 marks
- **Portfolio** - 05 marks

Suggestive verbs for various competencies

- **Demonstrate Knowledge and Understanding**

  State, name, list, identify, define, suggest, describe, outline, summarize, etc.

- Application of Knowledge/Concepts

  Calculate, illustrate, show, adapt, explain, distinguish, etc.

- Formulate, Analyze, Evaluate and Create

  Interpret, analyze, compare, contrast, examine, evaluate, discuss, construct, etc.

Reading Material
Class X (2026-27)
Science 086

Unit 1
Periodic Classification of Elements

In Class IX we have learnt that matter around us is present in the form of elements, compounds and mixtures and the elements contain atoms of only one type. Do you know how many elements are known till date? At present, 118 elements are known to us. All these have different properties. Out of these 118, only 94 are naturally occurring. As different elements were being discovered, scientists gathered more and more information about the properties of these elements. They found it difficult to organise all that was known about the elements. They started looking for some pattern in their properties, on the basis of which they could study such a large number of elements with ease.

1.1 Making Order Out Of Chaos–Early Attempts at the Classification of Elements

Figure 5.1
Imagine you and your friends have found pieces of an old map to reach a treasure. Would it be easy or chaotic to find the way to the treasure? Similar chaos was there in Chemistry as elements were known but there was no clue as to how to classify and study about them.

We have been learning how various things or living beings can be classified on the basis of their properties. Even in other situations, we come across instances of organisation based on some properties. For example, in a shop, soaps are kept together at one place while biscuits are kept together elsewhere. Even among soaps, bathing soaps are stacked separately from washing soaps. Similarly, scientists made several attempts to classify elements according to their properties and obtain an orderly arrangement out of chaos.

The earliest attempt to classify the elements resulted in grouping the then known elements as metals and non-metals. Later further classifications were tried out as our knowledge of elements and their properties increased.

1.1.1 Döbereiner's Triads

In the year 1817, Johann Wolfgang Döbereiner, a German chemist, tried to arrange the elements with similar properties into groups. He identified some groups having three elements each. So he called these groups 'triads'. Döbereiner showed that when the three elements in a triad were written in the order of increasing atomic masses; the atomic mass of the middle element was roughly the average of the atomic masses of the other two elements.

For example, take the triad consisting of lithium (Li), sodium (Na) and potassium (K) with the respective atomic masses 6.9, 23.0 and 39.0. What is the average of the atomic masses of Li and K? How does this compare with the atomic mass of Na?

Given below (Table 1) are some groups of three elements. These elements are arranged downwards in order of increasing atomic masses. Can you find out which of these groups form Döbereiner triads?

Table 1

Group A elements	Atomic Mass	Group B elements	Atomic Mass	Group C elements	Atomic Mass
N	14.0	Ca	40.1	Cl	35.5
P	31.0	Sr	87.6	Br	79.9
As	74.9	Ba	137.3	I	126.9

You will find that groups B and C form Döbereiner triads. Döbereiner could identify only three triads from the elements known at that time (Table 2). Hence, this system of classification into triads was not found to be useful.

Table 2 Döbereiner triads

Li	Ca	Cl
Na	Sr	Br
K	Ba	I

Johann Wolfgang Döbereiner (1790-1849)

Johann Wolfgang Döbereiner studied as a pharmacist at Münchberg in Germany, and then studied chemistry at Strasbourg. Eventually he became a professor of chemistry and pharmacy at the University of Jena. Döbereiner made the first observations on platinum as a catalyst and discovered similar triads of elements which led to the development of the Periodic Table of elements.

1.1.2 Newlands' Law of Octaves

The attempts of Döbereiner encouraged other chemists to correlate the properties of elements with their atomic masses. In 1866, John Newlands, an English scientist, arranged the then known elements in the order of increasing atomic masses. He started with the element having the lowest atomic mass (hydrogen) and ended at thorium which was the 56th element. He found that every eighth element had properties similar to that of the first. He compared this to the octaves found in music. Therefore, he called it the 'Law of Octaves'. It is known as 'Newlands' Law of Octaves'. In Newlands' Octaves, the properties of lithium and sodium were found to be the same. Sodium is the eighth element after lithium. Similarly, beryllium and magnesium resemble each other. A part of the original form of Newlands' Octaves is given in Table 3.

Table 3: Newlands' Octaves

Notes of music:	sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
	H	Li	Be	B	C	N	O
	F	Na	Mg	Al	Si	P	S
	Cl	K	Ca	Cr	Ti	Mn	Fe
	Co and Ni	Cu	Zn	Y	In	As	Se
	Br	Rb	Sr	Ce and La	Zr	—	—

Do You Know?

Are you familiar with musical notes?

In the Indian system of music, there are seven musical notes in a scale – *sa, re, ga, ma, pa, dha, ni*. In the west, they use the notations – *do, re, mi, fa, so, la, ti*. The notes in a scale are separated by whole and half-step frequency intervals of tones and semitones. A musician uses these notes for composing the music of a song. Naturally, there must be some repetition of notes. Every eighth note is similar to the first one and it is the first note of the next scale.

- It was found that the Law of Octaves was applicable only upto calcium, as after calcium every eighth element did not possess properties similar to that of the first.
- It was assumed by Newlands that only 56 elements existed in nature and no more elements would be discovered in the future. But, later on, several new elements were discovered, whose properties did not fit into the Law of Octaves.
- In order to fit elements into his Table, Newlands adjusted two elements in the same slot, but also put some unlike elements under the same note. Can you find examples of these from Table 3? Note that cobalt and nickel are in the same slot and these are placed in the same column as fluorine, chlorine and bromine which have very different properties than these elements. Iron, which resembles cobalt and nickel in properties, has been placed far away from these elements.

Thus, Newlands' Law of Octaves worked well with lighter elements only.

Questions

1. Did Döbereiner's triads also exist in the columns of Newlands' Octaves? Compare and find out.
2. What were the limitations of Döbereiner's classification?
3. What were the limitations of Newlands' Law of Octaves?

1.2 Making Order Out of Chaos – Mendeléev's Periodic Table

Even after the rejection of Newlands' Law of Octaves, many scientists continued to search for a pattern that correlated the properties of elements with their atomic masses.

The main credit for classifying elements goes to Dmitri Ivanovich Mendeléev, a Russian chemist. He was the most important contributor to the early development of a Periodic Table of elements wherein the elements were arranged on the basis of their fundamental property, the atomic mass, and also on the similarity of chemical properties.

Dmitri Ivanovich Mendeléev (1834–1907)

Dmitri Ivanovich Mendeléev was born in Tobolsk in Western Siberia, Russia on 8 February 1834. After his early education, Mendeléev could join a university only due to the efforts of his mother. Dedicating his investigations to his mother he wrote, "She instructed with example, corrected with love and travelled with me to places spending her last resources and strength. She knew that with the aid of science without violence, with love but firmness, all superstitions, untruth and errors can be removed." The arrangement of elements he proposed is called Mendeléev's Periodic Table. The Periodic Table proved to be the unifying principle in chemistry. It was the motivation for the discovery of some new elements.

When Mendeléev started his work, 63 elements were known. He examined the relationship between the atomic masses of the elements and their physical and chemical properties. Among chemical properties, Mendeléev concentrated on the compounds formed by elements with oxygen and hydrogen. He selected hydrogen and oxygen as they are very reactive and formed compounds with most elements. The formulae of the hydrides and oxides formed by an element were treated as one of the basic properties of an element for its classification. He then took 63 cards and on each card he wrote down the properties of one element. He sorted out the elements with similar properties and pinned the cards together on a wall. He observed that most of the elements got a place in a Periodic Table and were arranged in the order of their increasing atomic masses. It was also observed that there occurs a periodic recurrence of elements with similar physical and chemical properties. On this basis, Mendeléev formulated a Periodic Law, which states that 'the properties of elements are the periodic function of their atomic masses'.

Mendeléev's Periodic Table contains vertical columns called 'groups' and horizontal rows called 'periods' (Table 4).

Table 4: Mendeléev's Periodic Table

Group	I	II	III	IV	V	VI	VII	VIII
Oxide Hydride	R_2O RH	RO RH_4	R_2O_3 RH_3	RO_2 RH_4	R_2O_5 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
Periods ↓	A B	A B	A B	A B	A B	A B	A B	Transition series
1	H 1.008							
2	Li 6.939	Be 9.012	B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	
3	Na 22.99	Mg 24.31	Al 29.98	Si 28.09	P 30.974	S 32.06	Cl 35.453	
4 First series: Second series:	K 39.102 Cu 63.54	Ca 40.08 Zn 65.37	Sc 44.96 Ga 69.72	Ti 47.90 Ge 72.59	V 50.94 As 74.92	Cr 50.20 Se 78.96	Mn 54.94 Br 79.909	Fe 55.85 Co 58.93 Ni 58.71
5 First series: Second series:	Rb 85.47 Ag 107.87	Sr 87.62 Cd 112.40	Y 88.91 In 114.82	Zr 91.22 Sn 118.69	Nb 92.91 Sb 121.75	Mo 95.94 Te 127.60	Tc 99 I 126.90	Ru 101.07 Rh 102.91 Pd 106.4
6 First series: Second series:	Cs 132.90 Au 196.97	Ba 137.34 Hg 200.59	La 138.91 Tl 204.37	Hf 178.49 Pb 207.19	Ta 180.95 Bi 208.98	W 183.85		Os 190.2 Ir 192.2 Pt 195.09

Mendeléev's Periodic Table was published in a German journal in 1872. In the formula for oxides and hydrides at the top of the columns, the letter 'R' is used to represent any of the elements in the group. Note the way formulae are written. For example, the hydride of carbon, CH_4, is written as RH_4 and the oxide CO_2, as RO_2.

1.2.1 Achievements of Mendeléev's Periodic Table

While developing the Periodic Table, there were a few instances where Mendeléev had to place an element with a slightly greater atomic mass before an element with a slightly lower atomic mass. The sequence was inverted so that elements with similar properties could be grouped together. For example, cobalt (atomic mass 58.9) appeared before nickel (atomic mass 58.7). Looking at Table 4, can you find out one more such anomaly?

Further, Mendeléev left some gaps in his Periodic Table. Instead of looking upon these gaps as defects, Mendeléev boldly predicted the existence of some elements that had not been discovered at that time. Mendeléev named them by prefixing a Sanskrit numeral, Eka (one) to the name of preceding element in the same group. For instance, scandium, gallium and germanium, discovered later, have properties similar to Eka–boron, Eka–aluminium and Eka–silicon, respectively. The properties of Eka–Aluminium predicted by Mendeléev and those of the element, gallium which was discovered later and replaced Ekaaluminium, are listed as follows (Table 5).

Table 5 : Properties of eka–aluminium and gallium

Property	Eka-aluminium	Gallium
Atomic Mass	68	69.7
Formula of Oxide	E_2O_3	Ga_2O_3
Formula of Chloride	ECl_3	$GaCl_3$

Compounds of H	Compounds of Na
HCl	NaCl
H_2O	Na_2O
H_2S	Na_2S

This provided convincing evidence for both the correctness and usefulness of Mendeléev's Periodic Table. Further, it was the extraordinary success of Mendeléev's prediction that led chemists not only to accept his Periodic Table but

also recognise him, as the originator of the concept on which it is based. Noble gases like helium (He), neon (Ne) and argon (Ar) have been mentioned in many a context before this. These gases were discovered very late because they are very inert and present in extremely low concentrations in our atmosphere. One of the strengths of Mendeléev's Periodic Table was that, when these gases were discovered, they could be placed in a new group without disturbing the existing order.

1.2.2 Limitations of Mendeléev's Classification

Electronic configuration of hydrogen resembles that of alkali metals. Like alkali metals, hydrogen combines with halogens, oxygen and sulphur to form compounds having similar formulae, as shown in the examples here.

On the other hand, just like halogens, hydrogen also exists as diatomic molecules and it combines with metals and non-metals to form covalent compounds.

Activity 1

- Looking at its resemblance to alkali metals and the halogen family, try to assign hydrogen a correct position in Mendeléev's Periodic Table.
- To which group and period should hydrogen be assigned?

Certainly, no fixed position can be given to hydrogen in the Periodic Table. This was the first limitation of Mendeléev's Periodic Table. He could not assign a correct position to hydrogen in his Table.

Isotopes were discovered long after Mendeléev had proposed his periodic classification of elements. Let us recall that isotopes of an element have similar chemical properties, but different atomic masses.

Activity 2

- Consider the isotopes of chlorine, Cl-35 and Cl-37.
- Would you place them in different slots because their atomic masses are different?
- Or would you place them in the same position because their chemical properties are the same?

Thus, isotopes of all elements posed a challenge to Mendeleev's Periodic Law. Another problem was that the atomic masses do not increase in a regular manner in going from one element to the next. So it was not possible to predict how many elements could be discovered between two elements — especially when we consider the heavier elements.

Questions

1. Use Mendeléev's Periodic Table to predict the formulae for the oxides of the following elements:
   K, C, Al, Si, Ba.
2. Besides gallium, which other elements have since been discovered that were left by Mendeléev in his Periodic Table? (any two)
3. What were the criteria used by Mendeléev in creating his Periodic Table?
4. Why do you think the noble gases are placed in a separate group?

1.3 Making Order Out of Chaos – The Modern Periodic Table

In 1913, Henry Moseley showed that the atomic number (Symbolished as Z) of an element is a more fundamental property than its atomic mass as described below. Accordingly, Mendeléev's Periodic Law was modified and atomic number was adopted as the basis of Modern Periodic Table and the Modern

Periodic Law can be stated as follows:

'Properties of elements are a periodic function of their atomic number.'

Let us recall that the atomic number gives us the number of protons in the nucleus of an atom and this number increases by one in going from one element to the next. Elements, when arranged in order of increasing atomic number Z, lead us to the classification known as the Modern Periodic Table (Table 6). Prediction of properties of elements could be made with more precision when elements were arranged on the basis of increasing atomic number.

Activity 3

- How were the positions of cobalt and nickel resolved in the Modern Periodic Table?
- How were the positions of isotopes of various elements decided in the Modern Periodic Table?
- Is it possible to have an element with atomic number 1.5 placed between hydrogen and helium?
- Where do you think should hydrogen be placed in the Modern Periodic Table?

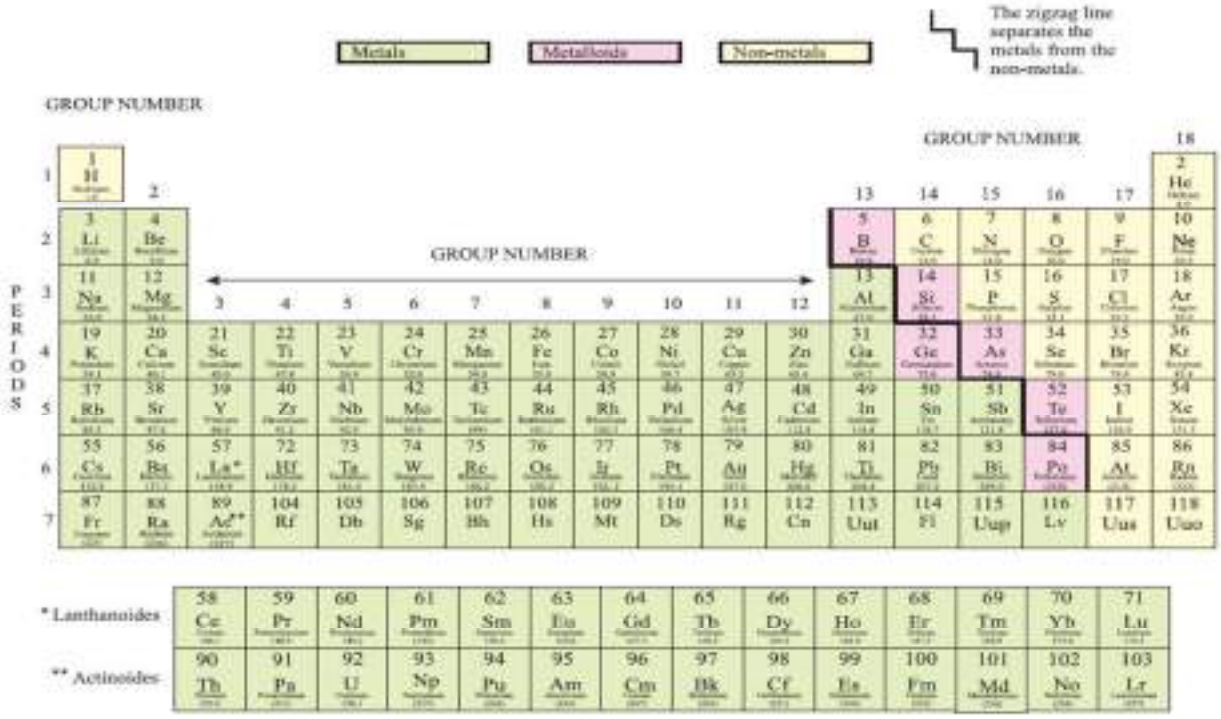


Table 6: Modern Periodic Table

As we can see, the Modern Periodic Table takes care of three limitations of Mendléev's Periodic Table. The anomalous position of hydrogen can be discussed after we see what are the bases on which the position of an element in the Modern Periodic Table depends.

1.3.1 Position of Elements in the Modern Periodic Table

The Modern Periodic Table has 18 vertical columns known as 'groups' and 7 horizontal rows known as 'periods'. Let us see what decides the placing of an element in a certain group and period.

Activity 4

- Look at the group 1 of the Modern Periodic Table, and name the elements present in it.
- Write down the electronic configuration of the first three elements of group 1.
- What similarity do you find in their electronic configurations?
- How many valence electrons are present in these three elements?

You will find that all these elements contain the same number of valence electrons. Similarly, you will find that the elements present in any one group have the same number of valence electrons. For example, elements fluorine (F) and chlorine (Cl), belong to group 17, how many electrons do fluorine and chlorine have in their outermost shells? Hence, we can say that groups in the Periodic Table signify an identical outershell electronic configuration. On the other hand, the number of shells increases as we go down the group.

There is an anomaly when it comes to the position of hydrogen because it can be placed either in group 1 or group 17 in the first period.

Can you say why?

Activity 5

- If you look at the long form of the Periodic Table, you will find that the elements Li, Be, B, C, N, O, F, and Ne are present in the second period. Write down their electronic configuration.
- Do these elements also contain the same number of valence electrons?
- Do they contain the same number of shells?

You will find that these elements do not have the same number of valence electrons, but they contain the same number of shells. You also observe that the number of valence shell electrons increases by one unit, as the atomic number increases by one unit on moving from left to right in a period.

Or we can say that atoms of different elements with the same number of occupied shells are placed in the same period. Na, Mg, Al, Si, P, S, Cl and Ar belong to the third period of the Modern Periodic Table, since the electrons in the atoms of these elements are filled in K, L and M shells. Write the electronic configuration of these elements and confirm the above statement. Each period marks a new electronic shell getting filled.

How many elements are there in the first, second, third and fourth periods?

We can explain the number of elements in these periods based on how electrons are filled into various shells. You will study the details of this in higher classes. Recall that the maximum number of electrons that can be accommodated in a shell depends on the formula $2n^2$ where 'n' is the number of the given shell from the nucleus.

For example,
K Shell – $2 \times (1)^2 = 2$, hence the first period has 2 elements.
L Shell – $2 \times (2)^2 = 8$, hence the second period has 8 elements.
M Shell – $2 \times (3)^2 = 18$, but the outermost shell can have only 8 electrons, so the third period also has only 8 elements.

The position of an element in the Periodic Table tells us about its chemical reactivity. As you have learnt, the valence electrons determine the kind and number of bonds formed by an element. Can you now say why Mendeléev's choice of formulae of compounds as the basis for deciding the position of an element in his Table was a good one? How would this lead to elements with similar chemical properties being placed in the same group?

1.3.2 Trends in the Modern Periodic Table

Valency: As you know, the valency of an element is determined by the number of valence electrons present in the outermost shell of its atom.

Activity 6

- How do you calculate the valency of an element from its electronic configuration?
- What is the valency of magnesium with atomic number 12 and sulphur with atomic number 16?
- Similarly find out the valencies of the first twenty elements.
- How does the valency vary in a period on going from left to right?
- How does the valency vary in going down a group?

Atomic size: The term atomic size refers to the radius of an atom. The atomic size may be visualised as the distance between the centre of the nucleus and the outermost shell of an isolated atom. The atomic radius of hydrogen atom is 37 pm (picometre, 1 pm = 10^{-12}m).

Let us study the variation of atomic size in a group and in a period.

Activity 7

- Atomic radii of the elements of the second period are given below:

Period II elements:	B	Be	O	N	Li	C
Atomic radius (pm):	88	111	66	74	152	77

- Arrange them in decreasing order of their atomic radii.
- Are the elements now arranged in the pattern of a period in the Periodic Table?
- Which elements have the largest and the smallest atoms?
- How does the atomic radius change as you go from left to right in a period?

You will see that the atomic radius decreases in moving from left to right along a period. This is due to an increase in nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom.

Activity 8

- Study the variation in the atomic radii of first group elements given below and arrange them in an increasing order.

Group 1 Elements:	Na	Li	Rb	Cs	K
Atomic Radius (pm):	186	152	244	262	231

- Name the elements which have the smallest and the largest atoms.
- How does the atomic size vary as you go down a group?

You will see that the atomic size increases down the group. This is because new shells are being added as we go down the group. This increases the distance between the outermost electrons and the nucleus so that the atomic size increases in spite of the increase in nuclear charge.

Metallic and Non-metallic Properties

Activity 9

- Examine elements of the third period and classify them as metals and non-metals.
- On which side of the Periodic Table do you find the metals?
- On which side of the Periodic Table do you find the non-metals?

As we can see, the metals like Na and Mg are towards the left-hand side of the Periodic Table while the non-metals like sulphur and chlorine are found on the right-hand side. In the middle, we have silicon, which is classified as a semi-metal or metalloid because it exhibits some properties of both metals and non-metals.

In the Modern Periodic Table, a zig-zag line separates metals from non-metals. The borderline elements – boron, silicon, germanium, arsenic, antimony, tellurium and polonium – are intermediate in properties and are called metalloids or semi-metals.

As you have seen in Metals and Non-Metals, metals tend to lose electrons while forming bonds, that is, they are electropositive in nature.

Activity 10

- How do you think the tendency to lose electrons will change in a group?
- How will this tendency change in a period?

As the effective nuclear charge acting on the valence shell electrons increases across a period, the tendency to lose electrons will decrease. Down the group, the effective nuclear charge experienced by valence electrons is decreasing because the outermost electrons are farther away from the nucleus. Therefore, these can be lost easily. Hence metallic character decreases across a period and increases down a group.

Non-metals, on the other hand, are electronegative. They tend to form bonds by gaining electrons. Let us learn about the variation of this property.

Activity 11

- How would the tendency to gain electrons change as you go from left to right across a period?
- How would the tendency to gain electrons change as you go down a group?

As the trends in the electronegativity show, non-metals are found on the right-hand side of the Periodic Table towards the top.

These trends also help us to predict the nature of oxides formed by the elements because it is known to you that the oxides of metals are basic and that of non-metals are acidic in general.

Questions

1. How could the Modern Periodic Table remove various anomalies of Mendeléev's Periodic Table?
2. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice?
3. Name
   (a) three elements that have a single electron in their outermost shells.

(b) two elements that have two electrons in their outermost shells.
(c) three elements with filled outermost shells.

4. (a) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?
   (b) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common?
5. In the Modern Periodic Table, which are the metals among the first ten elements?
6. By considering their position in the Periodic Table, which one of the following elements would you expect to have maximum metallic characteristic?
   Ga Ge As Se Be

What you have learnt

- Elements are classified on the basis of similarities in their properties.
- Döbereiner grouped the elements into triads and Newlands gave the Law of Octaves.
- Mendeléev arranged the elements in increasing order of their atomic masses and according to their chemical properties.
- Mendeléev even predicted the existence of some yet to be discovered elements on the basis of gaps in his Periodic Table.
- Anomalies in arrangement of elements based on increasing atomic mass could be removed when the elements were arranged in order of increasing atomic number, a fundamental property of the element discovered by Moseley.
- Elements in the Modern Periodic Table are arranged in 18 vertical columns called groups and 7 horizontal rows called periods.
- Elements thus arranged show periodicity of properties including atomic size, valency or combining capacity and metallic and non-metallic character.

Exercise

1. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic Table.
   (a) The elements become less metallic in nature.
   (b) The number of valence electrons increases.
   (c) The atoms lose their electrons more easily.
   (d) The oxides become more acidic.
2. Element X forms a chloride with the formula XCl_2, which is a solid with a high melting point. X would most likely be in the same group of the Periodic Table as
   (a) Na (b) Mg (c) Al (d) Si
3. Which element has
   (a) two shells, both of which are completely filled with electrons?
   (b) the electronic configuration 2, 8, 2?
   (c) a total of three shells, with four electrons in its valence shell?
   (d) a total of two shells, with three electrons in its valence shell?
   (e) twice as many electrons in its second shell as in its first shell?
4.
   (a) What property do all elements in the same column of the Periodic Table as boron have in common?
   (b) What property do all elements in the same column of the Periodic Table as fluorine have in common?
5. An atom has electronic configuration 2, 8, 7.
   (a) What is the atomic number of this element?

(b) To which of the following elements would it be chemically similar? (Atomic numbers are given in parentheses.)

N(7) F(9) P(15) Ar(18)

6. The position of three elements A, B and C in the Periodic Table are shown below –

Group 16	*Group 17*
-	-
-	A
-	-
B	C

(a) State whether A is a metal or non-metal.

(b) State whether C is more reactive or less reactive than A.

(c) Will C be larger or smaller in size than B?

(d) Which type of ion, cation or anion, will be formed by element A?

7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the Periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?
8. How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?
9. In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?
10. Compare and contrast the arrangement of elements in Mendeléev's Periodic Table and the Modern Periodic Table.

Group Activity

I. We have discussed the major attempts made for classifying elements. Find out (from the internet or library) about other attempts to classify elements.

II. We have studied the long form of the Periodic Table. The Modern Periodic Law has been used to arrange elements in other ways too. Find out what are these.

Unit 2
Heredity and Evolution

2.1 Evolution

We have noted that there is an inbuilt tendency to variation during reproduction, both because of errors in DNA copying, and as a result of sexual reproduction. Let us now look at some consequences of this tendency.

2.1.1 An Illustration

Consider a group of twelve red beetles. They live, let us assume, in some bushes with green leaves. Their population will grow by sexual reproduction, and therefore, can generate variations. Let us imagine also that crows eat these beetles. The more beetles the crows eat; the fewer beetles are available to reproduce. Now, let us think about some different situations (Fig. 1) that can develop in this beetle population.

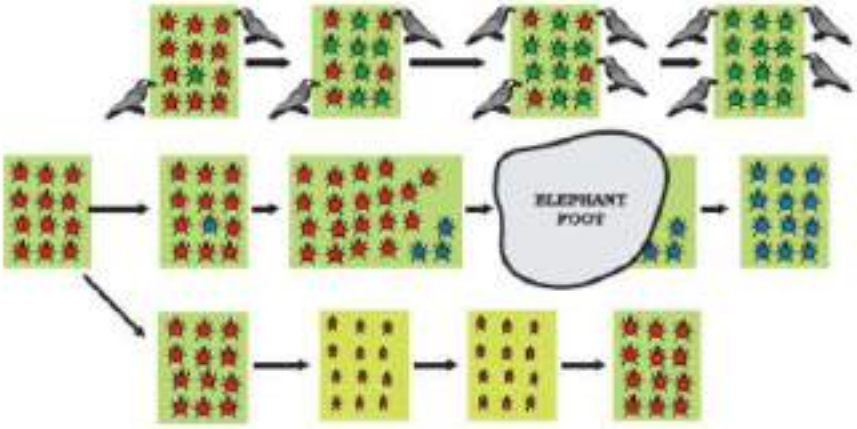


Fig. 1 *Variation in a population – inherited and otherwise*

In the first situation, a colour variation arises during reproduction, so that there is one beetle that is green in colour instead of red. This beetle, moreover, can pass the colour on to its progeny, so that all its progeny beetles are green. Crows cannot see green-coloured beetles on the green leaves of the bushes, and therefore cannot eat them. What happens then? The progeny of green beetles is not eaten, while the progeny of red beetles continues to be eaten. As a result, there are more and more green beetles than red ones in the beetle population.

In a second situation, again, a colour variation arises during reproduction, but now it results in a beetle that is blue in colour instead of red. This beetle can also pass the colour on to its progeny, so that all its progeny beetles are blue. Crows can see blue-coloured beetles in the green leaves of the bushes as well as they can see red ones, and therefore can eat them. What happens initially? In the population, as it expands, there are a few blue beetles, but most are red. But at this point, an elephant comes by, and stamps on the bushes where the beetles live. This kills most of the beetles. By chance, the few beetles that have survived are mostly blue. The beetle population slowly expands again, but now, the beetles in the population are mostly blue.

It is obvious that in both situations, what started out as a rare variation came to be a common characteristic in the population. In other words, the frequency of an inherited trait changed over generations. Since genes control traits, we can say that the frequency of certain genes in a population changed over generations. This is the essence of the idea of evolution.

But there are interesting differences, too, in the two situations. In the first case, the variation became common because it gave a survival advantage. In other words, it was naturally selected. We can see that the natural selection is exerted by the crows. The more crows there are, the more red beetles would be eaten, and the more the proportion of green beetles in the population would be. Thus, natural selection is directing evolution in the beetle population. It results in adaptations in the beetle population to fit their environment better.

In the second situation, the colour change gave no survival advantage. Instead, it was simply a matter of accidental survival of beetles of one colour that changed the common characteristic of the resultant population. The elephant would not have caused such major havoc in the beetle population if the beetle population had been very large. So, accidents in small populations can change the frequency of some genes in a population, even if they give no survival advantage. This is the notion of genetic drift, which provides diversity without any adaptations.

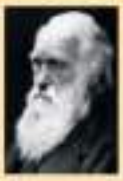
Now consider a third situation. In this, as the beetle population begins to expand, the bushes start suffering from a plant disease. The amount of leaf material for the beetles is reduced. The beetles are poorly nourished as a result. The average weight of adult beetles decreases from what it used to be when leaves were plentiful, but there is no genetic change occurring. After a few years and a few beetle generations of such scarcity, the plant disease is eliminated. There is a lot of leaf food. At this time, what would we expect the weight of the beetles to be?

2.1.2 Acquired and Inherited Traits

We discussed the idea that the germ cells of sexually reproducing populations are made in specialised reproductive tissue. If the weight of the beetle is reduced because of starvation, that will not change the DNA of the germ cells. Therefore, low weight is not a trait that can be inherited by the progeny of a starving beetle. Therefore, even if some generations of beetles are low in weight because of starvation, that is not an example of evolution, since the change is not inherited over generations. Change in non-reproductive tissues cannot be passed on to the DNA of the germ cells. Therefore, the experiences of an individual during its lifetime cannot be passed on to its progeny, and cannot direct evolution.

Consider another example of how an individual cannot pass on to its progeny the experiences of its lifetime. If we breed a group of mice, all their progeny will have tails, as expected. Now, if the tails of these mice are removed by surgery in each generation, do these tailless mice have tailless progeny? The answer is no, and it makes sense because removal of the tail cannot change the genes of the germ cells of the mice.

Charles Robert Darwin (1809–1882)



Charles Darwin set out on a voyage when he was 22 years old. The five-year voyage took him to South America and the islands off its coast. The studies that he conducted during this voyage were to change forever the way we look at the variety of life on earth. Interestingly, after he got back to England, he never left its shores again. He stayed at home and conducted various experiments that led him to formulate his hypothesis that evolution took place due to natural selection. He did not know the mechanism whereby variations arose in the species. He would have been enlightened by Mendel's experiments, but these two gentlemen did not know of each other or their work!

We often associate Darwin solely with the theory of evolution. But he was an accomplished naturalist, and one of the studies he conducted was to do with the role of earthworms in soil fertility.

This is the reason why the ideas of heredity and genetics that we have discussed earlier are so essential for understanding evolution. Even Charles Darwin, who came up with the idea of evolution of species by natural selection in the nineteenth century, could not work out the mechanism. It is ironic that he could have done so if he had seen the significance of the experiments his

Austrian contemporary, Gregor Mendel, was doing. But then, Mendel too did not notice Darwin's work as relevant to his!

Do You Know? Origin of life on earth

Darwin's theory of evolution tells us how life evolved from simple to more complex forms and Mendel's experiments give us the mechanism for the inheritance of traits from one generation to the next. But neither tells us anything about how life began on earth in the first place. J.B.S. Haldane, a British scientist (who became a citizen of India later), suggested in 1929 that life must have developed from the simple inorganic molecules which were present on earth soon after it was formed. He speculated that the conditions on earth at that time, which were far from the conditions we see today, could have given rise to more complex organic molecules that were necessary for life. The first primitive organisms would arise from further chemical synthesis.

How did these organic molecules arise? An answer was suggested by the experiment conducted by Stanley L. Miller and Harold C. Urey in 1953. They assembled an atmosphere similar to that thought to exist on early earth (this had molecules like ammonia, methane and hydrogen sulphide, but no oxygen) over water. This was maintained at a temperature just below 100°C and sparks were passed through the mixture of gases to simulate lightning. At the end of a week, 15% of the carbon (from methane) had been converted to simple compounds of carbon including amino acids which make up protein molecules. So, can life arise afresh on earth even now?

Question

1. What are the different ways in which individuals with a particular trait may increase in a population?
2. Why are traits acquired during the life-time of an individual not inherited?
3. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

2.2 Speciation

What we have seen so far is micro-evolution. That means that the changes are small, even though they are significant. Also, they simply change the common characteristics of a particular species. But this does not properly explain how new species come into existence. That can be said to have happened only if this group of beetles we are thinking about, splits into two populations that cannot reproduce with each other. When this happens, they can be called two independent species. So, can we extend the reasoning we have used above to explain such speciation?

Consider what would happen if the bushes the beetles feed on are spread widely over a mountain range. The beetle population becomes very large as a result. But individual beetles feed mostly on a few nearby bushes throughout their lifetime. They do not travel far. So, in this huge population of beetles, there will be sub-populations in neighbourhoods. Since male and female beetles have to meet for reproduction to happen, most reproduction will be within these sub-populations. Of course, an occasional adventurous beetle might go from one site to another. Or a beetle is picked up by a crow from one site and dropped in the other site without being eaten. In either case, the migrant beetle will reproduce with the local population. This will result in the genes of the migrant beetle entering a new population. This kind of gene flow is bound to happen between populations that are partly, but not completely separated. If, however, between two such sub-populations a large river comes into existence, the two

populations will be further isolated. The levels of gene flow between them will decrease even further.

Over generations, genetic drift will accumulate different changes in each sub-population. Also, natural selection may also operate differently in these different geographic locations. Thus, for example, in the territory of one sub-population, crows are eliminated by eagles. But this does not happen for the other sub-population, where crow numbers are very high. As a result, the green variation will not be selected at the first site, while it will be strongly selected at the second.

Together, the processes of genetic drift and natural selection will result in these two isolated sub-populations of beetles becoming more and more different from each other. Eventually, members of these two groups will be incapable of reproducing with each other even if they happen to meet.

There can be a number of ways by which this can happen. If the DNA changes are severe enough, such as a change in the number of chromosomes, eventually the germ cells of the two groups cannot fuse with each other. Or a new variation emerges in which green females will not mate with red males, but only with green males. This allows very strong natural selection for greenness. Now, if such a green female beetle meets a red male from the other group, her behaviour will ensure that there is no reproduction between them. Effectively, new species of beetles are being generated.

Questions

1. What factors could lead to the rise of a new species?
2. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?
3. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

2.3 Evolution and Classification

Based on these principles, we can work out the evolutionary relationships of the species we see around us. It is a sort of going backwards in time. We can do this by identifying hierarchies of characteristics between

species. In order to understand this process, let us think back to our discussion on the classification of organisms in Class IX.

Similarities among organisms will allow us to group them and then study the groups. For this, which characteristics decide more fundamental differences among organisms, and which ones decide less basic differences? What is meant by ‘characteristics’, anyway? Characteristics are details of appearance or behaviour; in other words, a particular form or a particular function. That we have four limbs is thus a characteristic. That plants can do photosynthesis is also a characteristic.

Some basic characteristics will be shared by most organisms. The cell is the basic unit of life in all organisms. The characteristics in the next level of classification would be shared by most, but not all organisms. A basic characteristic of cell design that differs among different organisms is whether the cell has a nucleus. Bacterial cells do not, while the cells of most other organisms do. Among organisms with nucleated cells, which ones are unicellular and which ones multi-cellular? That property marks a very basic difference in body design, because of specialisation of cell types and tissues. Among multi-cellular organisms, whether they can undertake photosynthesis or not will

provide the next level of classification. Among the multi-cellular organisms that cannot do photosynthesis, whether the skeleton is inside the body or around the body will mark another fundamental design difference. We can see that, even in these few questions that we have asked, a hierarchy is developing that allows us to make classification groups.

The more characteristics two species will have in common, the more closely they are related. And the more closely they are related, the more recently they will have had a common ancestor. An example will help. A brother and a sister are closely related. They have common ancestors in the first generation before them, namely, their parents. A girl and her first cousin are also related, but less than the girl and her brother. This

is because cousins have common ancestors, their grandparents, in the second generation before them, not in the first one. We can now appreciate that classification of species is in fact a reflection of their evolutionary relationship.

We can thus build up small groups of species with recent common ancestors, then super-groups of these groups with more distant common ancestors, and so on. In theory, we can keep going backwards like this

until we come to the notion of a single species at the very beginning of evolutionary time. If that is the case, then at some point in the history of the earth, non-living material must have given rise to life. There are many theories about how this might have happened. It would be interesting to come up with theories of our own!

2.3.1 Tracing Evolutionary Relationships

When we try to follow evolutionary relationships, how do we identify characteristics as common? These characteristics in different organisms would be similar because they are inherited from a common ancestor.

As an example, consider the fact that mammals have four limbs, as do birds, reptiles and amphibians (Fig. 2). The basic structure of the limbs is similar though it has been modified to perform different functions in various vertebrates. Such a homologous characteristic helps to identify an evolutionary relationship between apparently different species.

Fig. 2 Homologous organs

However, all similarities simply in organ shape are not necessarily because of common ancestry. What would we think about the wings of birds and bats, for example (Fig. 3)? Birds and bats have wings, but squirrels and lizards do not. So are birds and bats more closely related to each other than to squirrels or lizards?

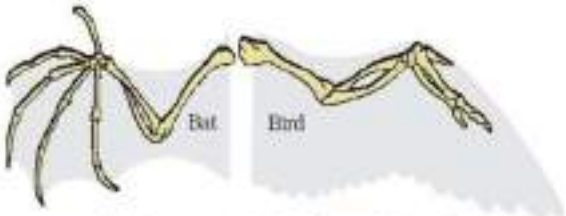


Fig 3 Analogous organs – The wing of a bat and the wing of a bird.

Before we jump to this conclusion, let us look at the wings of birds and bats more closely. When we do that, we find that the wings of bats are skin folds stretched mainly between elongated fingers. But the wings of birds are a feathery covering all along the arm. The designs of the two wings, their structure and components, are thus very different. They look similar because they have a common use for flying, but their origins

are not common. This makes them analogous characteristics, rather than homologous characteristics. It would now be interesting to think about whether bird arms and bat arms should be considered homologous or analogous!

2.3.2 Fossils

Such studies of organ structure can be done not only on current species, but also on species that are no longer alive. How do we know that these extinct species ever existed? We know this from finding fossils (Fig. 4). What are fossils? Usually, when organisms die, their bodies will decompose and be lost. But every once in a while, the body or at least some parts may be in an environment that does not let it decompose completely. If a dead insect gets caught in hot mud, for example, it will not decompose quickly, and the mud will eventually harden and retain the impression of the body parts of the insect. All such preserved traces of living organisms are called fossils.

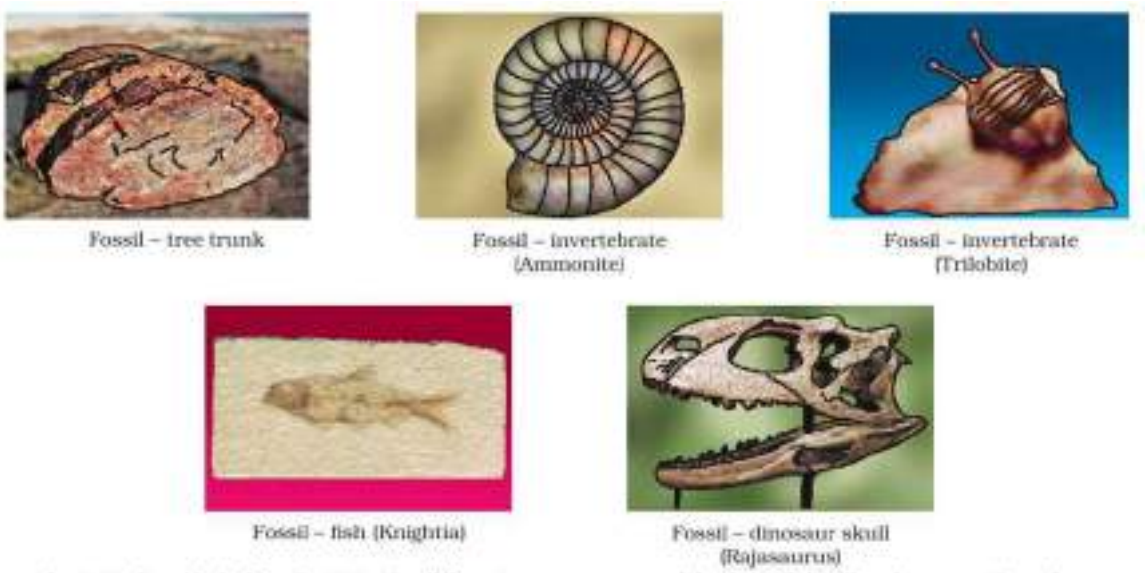


Fig. 4: Various kind of fossils. Note the different appearances and degrees of detail and preservation. The dinosaur skull fossil shown was found only a few years ago in the Narmada valley.

How do we know how old the fossils are? There are two components to this estimation. One is relative. If we dig into the earth and start finding fossils, it is reasonable to suppose that the fossils we find closer to the surface are more recent than the fossils we find in deeper layers. The second way of dating fossils is by detecting the ratios of different isotopes of the same element in the fossil material. It would be interesting to find out exactly how this method works!

How do fossils form layer by layer?

Let us start 100 million years ago. Some invertebrates on the sea-bed die, and are buried in the sand. More sand accumulates, and sandstone forms under pressure.

Millions of years later, dinosaurs living in the area die, and their bodies, too, are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.

Again, millions of years later, the bodies of horse-like creatures dying in the area are fossilised in rocks above these earlier rocks.

Much later, by erosion or water flow wears away some of the rock and exposes the horse-like fossils. As we dig deeper, we will find older and older fossils.

2.3.3 Evolution by Stages

A question that arises here is – if complicated organs, such as the eye, are selected for the advantage they provide, how can they be generated by a single DNA change? Surely such complex organs will be created bit-by-bit over generations? But how can each intermediate change be selected for? There are a number of possible explanations. Even an intermediate stage (Fig. 5), such as a rudimentary eye, can be useful to some extent. This might be enough to give a fitness advantage. In fact, the eye – like the wing – seems to be a very popular adaptation. Insects have them, so does an octopus, and so do vertebrates. And the structure of the eye in each of these organisms is different – enough for them to have separate evolutionary origins.

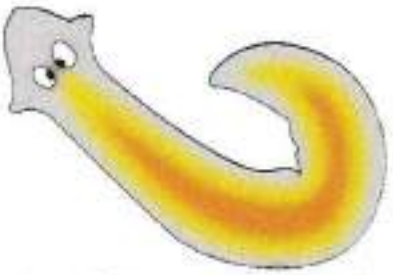


Fig. 5: A flatworm named Planaria has very simple 'eyes' that are really just eye-spots which detect light

Also, a change that is useful for one property to start with can become useful later for quite a different function. Feathers, for example, can start out as providing insulation in cold weather (Fig. 6). But later, they might become useful for flight. In fact, some dinosaurs had feathers, although they could not fly using the feathers. Birds seem to have later adapted the feathers to flight. This, of course, means that birds are very closely related to reptiles, since dinosaurs were reptiles!

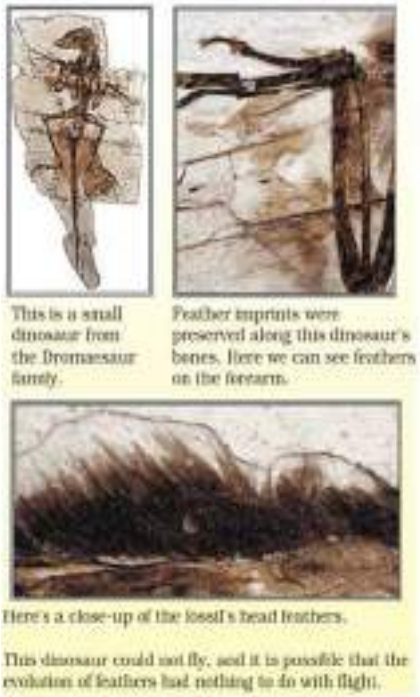


Fig. 6: Dinosaurs and the evolution of feathers

It is all very well to say that very dissimilar looking structures evolve from a common ancestral design. It is true that analysis of the organ structure in fossils allows us to make estimates of how far back evolutionary relationships go. But those are guesses about what happened in history. Are there any current examples of such a process?

The wild cabbage plant is a good example. Humans have, over more than two thousand years, cultivated wild cabbage as a food plant, and generated different vegetables from it by selection (see Fig. 7). This is, of course, artificial selection rather than natural selection. So some farmers have wanted to select for very short distances between leaves, and have bred the cabbage we eat. Some have wanted to select for arrested flower development, and have bred broccoli, or for sterile flowers, and have made the cauliflower. Some have selected for swollen parts, and come up with kohlrabi. Some have simply looked for slightly larger leaves, and come up with a leafy vegetable called kale. Would we have thought that all these structures are descended from the same ancestor if we had not done it ourselves?

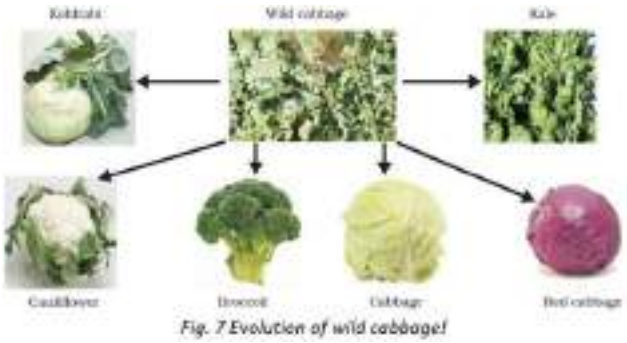


Fig. 7 Evolution of wild cabbage!

Another way of tracing evolutionary relationships depends on the original idea that we started with. That idea was that changes in DNA during reproduction are the basic events in evolution. If that is the case, then comparing the DNA of different species should give us a direct estimate of how much the DNA has changed during the formation of these species. This method is now extensively used to define evolutionary relationships.

Molecular phylogeny

We have been discussing how changes in the DNA during cell division would lead to changes in the proteins that are made from this new DNA. Another point that has been made is that these changes would accumulate from one generation to the next. Could this be used to trace the changes in DNA backwards in time and find out where each change diverged from the other? Molecular phylogeny does exactly this. This approach is based on the idea that organisms which are more distantly related will accumulate a greater number of differences in their DNA. Such studies trace the evolutionary relationships and it has been highly gratifying to find that the relationships among different organisms shown by molecular phylogeny match the classification scheme that we learnt in Class IX.

Questions

1. Give an example of characteristics being used to determine how close two species are in evolutionary terms.
2. Can the wing of a butterfly and the wing of a bat be considered homologous organs? Why or why not?
3. What are fossils? What do they tell us about the process of evolution?

2.4 Evolution should not be equated with ‘Progress’

In an exercise of tracing the family trees of species, we need to remember certain things. Firstly, there are multiple branches possible at each and every stage of this process. So it is not as if one species is eliminated to give rise to a new one. A new species has emerged. But that does not necessarily mean, like the beetle example we have been thinking about, that the old species will disappear. It will all depend on the environment. Also, it is not as if the newly generated species are in any way ‘better’ than the older

one. It is just that natural selection and genetic drift have together led to the formation of a population that cannot reproduce with the original one. So, for example, it is not true that human beings have evolved from chimpanzees. Rather, both human beings and chimpanzees have a common ancestor a long time ago. That common ancestor is likely to have been neither human or chimpanzee. Also, the first step of separation from that ancestor is unlikely to have resulted in modern chimpanzees and human beings. Instead, the two resultant species have probably evolved in their own separate ways to give rise to the current forms.

In fact, there is no real 'progress' in the idea of evolution. Evolution is simply the generation of diversity and the shaping of the diversity by environmental selection. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. However, again, it is not as if the older designs are inefficient! So many of the older and simpler designs still survive. In fact, one of the simplest life forms – bacteria – inhabit the most inhospitable habitats like hot springs, deep-sea thermal vents and the ice in Antarctica. In other words, human beings are not the pinnacle of evolution, but simply yet another species in the teeming spectrum of evolving life.

2.4.1 Human Evolution

The same tools for tracing evolutionary relationships – excavating, time-dating and studying fossils, as well as determining DNA sequences – have been used for studying human evolution. There is a great diversity of human forms and features across the planet. So much so that, for a long time, people used to talk about human 'races'. Skin colour used to be the commonest way of identifying these so called races. Some were called yellow, some black, white or brown. A major question debated for a long time was, have these apparent groups evolved differently? Over recent years, the evidence has become very clear. The answer is that there is no biological basis to the notion of human races. All humans are a single species.

Not only that, regardless of where we have lived for the past few thousand years, we all come from Africa. The earliest members of the human species, Homo sapiens, can be traced there. Our genetic footprints can be traced back to our African roots. A couple of hundred thousand years ago, some of our ancestors left Africa while others stayed on. While the residents spread across Africa, the migrants slowly spread across the planet – from Africa to West Asia, then to Central Asia, Eurasia, South Asia, East Asia. They travelled down the islands of Indonesia and the Philippines to Australia, and they crossed the Bering land bridge to the Americas. They did not go in a single line, so they were not travelling for the sake of travelling, obviously. They went forwards and backwards, with groups sometimes separating from each other, sometimes coming back to mix with each other, even moving in and out of Africa. Like all other species on the planet, they had come into being as an accident of evolution, and were trying to live their lives the best they could.

Questions

1. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?
2. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Unit 3
Magnetic Effects of Electric Current

3.1 Electric Motor

An electric motor is a rotating device that converts electrical energy to mechanical energy. Electric motor is used as an important component in electric fans, refrigerators, mixers, washing machines, computers, MP3 players etc. Do you know how an electric motor works?

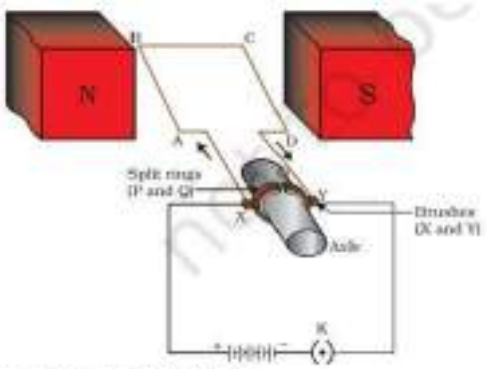


Fig. 1: A simple electric motor

An electric motor, as shown in Fig. 1, consists of a rectangular coil ABCD of insulated copper wire. The coil is placed between the two poles of a magnetic field such that the arm AB and CD are perpendicular to the direction of the magnetic field. The ends of the coil are connected to the two halves P and Q of a split ring. The inner sides of these halves are insulated and attached to an axle. The external conducting edges of P and Q touch two conducting stationary brushes X and Y, respectively, as shown in the Fig. 1.

Current in the coil ABCD enters from the source battery through conducting brush X and flows back to the battery through brush Y. Notice that the current in arm AB of the coil flows from A to B. In arm CD it flows from C to D, that is, opposite to the direction of current through arm AB. On applying Fleming's left hand rule for the direction of force on a current-carrying conductor in a magnetic field (see Fig. 13.13). We find that the force acting on arm AB pushes it downwards while the force acting on arm CD pushes it upwards. Thus the coil and the axle O, mounted free to turn about an axis, rotate anti-clockwise. At half rotation, Q makes contact with the brush X and P with brush Y. Therefore, the current in the coil gets reversed and flows along the path DCBA. A device that reverses the direction of flow of current through a circuit is called a commutator. In electric motors, the split ring acts as a commutator. The reversal of current also reverses the direction of force acting on the two arms AB and CD. Thus the arm AB of the coil that was earlier pushed down is now pushed up and the arm CD previously pushed up is now pushed down. Therefore, the coil and the axle rotate half a turn more in the same direction. The reversing of the current is repeated at each half rotation, giving rise to a continuous rotation of the coil and to the axle.

The commercial motors use (i) an electromagnet in place of permanent magnet; (ii) large number of turns of the conducting wire in the current carrying coil; and (iii) a soft iron core on which the coil is wound. The soft iron core, on which the coil is wound, plus the coils, is called an armature. This enhances the power of the motor.

Questions

1. State Fleming's left-hand rule.
2. What is the principle of an electric motor?
3. What is the role of the split ring in an electric motor?

3.2 Electromagnetic Induction

We have studied that when a current-carrying conductor is placed in a magnetic field such that the direction of current is perpendicular to the magnetic field, it experiences a force. This force causes the conductor to move. Now let us imagine a situation in which a conductor is moving inside a magnetic field or a magnetic field is changing around a fixed conductor. What will happen? This was first studied by English physicist Michael Faraday. In 1831, Faraday made an important breakthrough by discovering how a moving magnet can be used to generate electric currents. To observe this effect, let us perform the following activity.

Activity

- Take a coil of wire AB having a large number of turns.
- Connect the ends of the coil to a galvanometer as shown in Fig. 13.16.
- Take a strong bar magnet and move its north pole towards the end B of the coil. Do you find any change in the galvanometer needle?
- There is a momentary deflection in the needle of the galvanometer, say to the right. This indicates the presence of a current in the coil AB. The deflection becomes zero the moment the motion of the magnet stops.
- Now withdraw the north pole of the magnet away from the coil. Now the galvanometer is deflected toward the left, showing that the current is now set up in the direction opposite to the first.
- Place the magnet stationary at a point near to the coil, keeping its north pole towards the end B of the coil. We see that the galvanometer needle deflects toward the right when the coil is moved towards the north pole of the magnet. Similarly, the needle moves toward left when the coil is moved away.
- When the coil is kept stationary with respect to the magnet, the deflection of the galvanometer drops to zero. What do you conclude from this activity?

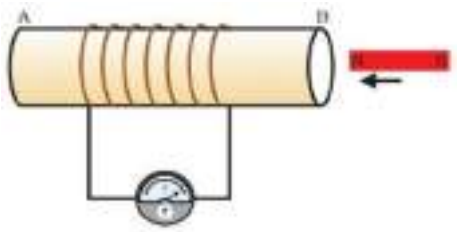


Fig. 2: Moving a magnet towards a coil sets up a current in the coil circuit, as indicated by deflection in the galvanometer needle.

A galvanometer is an instrument that can detect the presence of a current in a circuit. The pointer remains at zero (the centre of the scale) for zero current flowing through it. It can deflect either to the left or to the right of the zero mark depending on the direction of current.

You can also check that if you had moved south pole of the magnet towards the end B of the coil, the deflections in the galvanometer would just be opposite to the previous case. When the coil and the magnet are both stationary, there is no deflection in the galvanometer. It is, thus, clear from this activity that motion of a magnet with respect to the coil produces an induced potential difference, which sets up an induced electric current in the circuit.

Michael Faraday was an experimental physicist. He had no formal education. He worked in a book-binding shop during his early years. He used to read books that came for binding. This way Faraday developed his interest in science. He got an opportunity to listen to some public lectures by Humphrey Davy of Royal Institute. He made careful notes of Davy's lectures and sent them to Davy. Soon he was made an assistant

in Davy's laboratory at the Royal Institute. Faraday made several path-breaking discoveries that include electromagnetic induction and the laws of electrolysis. Several universities conferred on him the honorary degrees but he turned down such honours. Faraday loved his science work more than any honour.

Let us now perform a variation of Activity 13.8 in which the moving magnet is replaced by a current-carrying coil and the current in the coil can be varied.

Activity

- Take two different coils of copper wire having large number of turns (say 50 and 100 turns respectively). Insert them over a non-conducting cylindrical roll, as shown in Fig. 3. (You may use a thick paper roll for this purpose.)
- Connect the coil-1, having larger number of turns, in series with a battery and a plug key. Also connect the other coil-2 with a galvanometer as shown.

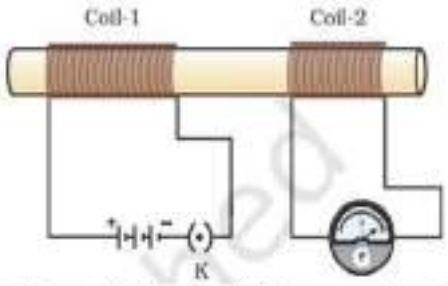


Fig. 3 Current is induced in coil-2 when current in coil-1 is changed

- Plug in the key. Observe the galvanometer. Is there a deflection in its needle? You will observe that the needle of the galvanometer instantly jumps to one side and just as quickly returns to zero, indicating a momentary current in coil-2.
- Disconnect coil-1 from the battery. You will observe that the needle momentarily moves, but to the opposite side. It means that now the current flows in the opposite direction in coil-2.

In this activity we observe that as soon as the current in coil-1 reaches either a steady value or zero, the galvanometer in coil-2 shows no deflection.

From these observations, we conclude that a potential difference is induced in the coil-2 whenever the electric current through the coil–1 is changing (starting or stopping). Coil-1 is called the primary coil and coil-2 is called the secondary coil. As the current in the first coil changes, the magnetic field associated with it also changes. Thus the magnetic field lines around the secondary coil also change. Hence the change in magnetic field lines associated with the secondary coil is the cause of induced electric current in it. This process, by which a changing magnetic field in a conductor induces a current in another conductor, is called electromagnetic induction. In practice we can induce current in a coil either by moving it in a magnetic field or by changing the magnetic field around it. It is convenient in most situations to move the coil in a magnetic field.

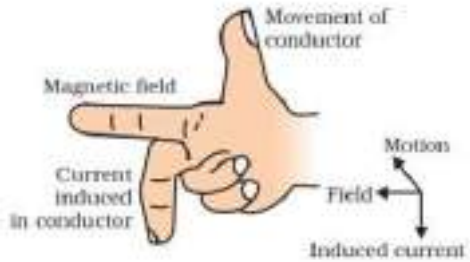


Fig. 4: Fleming's right-hand rule

The induced current is found to be the highest when the direction of motion of the coil is at right angles to the magnetic field. In this situation, we can use a simple rule to know the direction of the induced current. Stretch the thumb, forefinger and middle finger of right hand so that they are perpendicular to each other, as shown in Fig. 4. If the forefinger indicates the direction of the magnetic field and the thumb shows the direction of motion of conductor,

then the middle finger will show the direction of induced current. This simple rule is called Fleming's right-hand rule.

Question

1. Explain different ways to induce current in a coil.

3.3 Electric Generator

Based on the phenomenon of electromagnetic induction, the experiments studied above generate induced current, which is usually very small. This principle is also employed to produce large currents for use in homes and industry. In an electric generator, mechanical energy is used to rotate a conductor in a magnetic field to produce electricity.

An electric generator, as shown in Fig. 4, consists of a rotating rectangular coil ABCD placed between the two poles of a permanent magnet. The two ends of this coil are connected to the two rings R1 and R2. The inner side of these rings are made insulated. The two conducting stationary brushes B1 and B2 are kept pressed separately on the rings R1 and R2, respectively. The two rings R1 and R2 are internally attached to an axle. The axle may be mechanically rotated from outside to rotate the coil inside the magnetic field. Outer ends of the two brushes are connected to the galvanometer to show the flow of current in the given external circuit.

When the axle attached to the two rings is rotated such that the arm AB moves up (and the arm CD moves down) in the magnetic field produced by the permanent magnet. Let us say the coil ABCD is rotated clockwise in the arrangement shown in Fig. 4. By applying Fleming's right-hand rule, the induced currents are set up in these arms along the directions AB and CD. Thus an induced current flows in the direction ABCD. If there are larger numbers of turns in the coil, the current generated in each turn adds up to give a large current through the coil. This means that the current in the external circuit flows from B2 to B1.

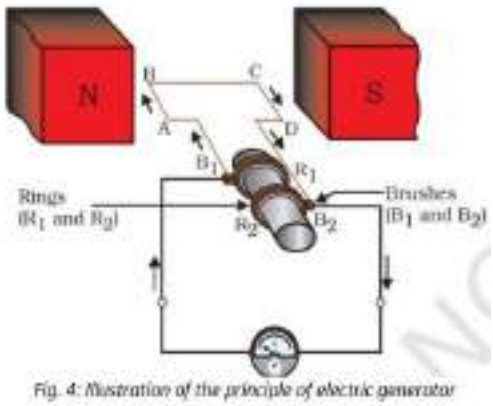


Fig. 4: Illustration of the principle of electric generator

After half a rotation, arm CD starts moving up and AB moving down. As a result, the directions of the induced currents in both the arms change, giving rise to the net induced current in the direction DCBA. The current in the external circuit now flows from B1 to B2. Thus after every half rotation the polarity of the current in the respective arms changes. Such a current, which changes direction after equal intervals of time, is called an alternating current (abbreviated as AC). This device is called an AC generator.

To get a direct current (DC, which does not change its direction with time), a split-ring type commutator must be used. With this arrangement, one brush is at all times in contact with the arm moving up in the field, while the other is in contact with the arm moving down. We have seen the working of a split ring commutator in the case of an electric motor (see Fig. 4). Thus a unidirectional current is produced. The generator is thus called a DC generator.

The difference between the direct and alternating currents is that the direct current always flows in one direction, whereas the alternating current reverses its direction

periodically. Most power stations constructed these days produce AC. In India, the AC changes direction after every 1/100 second, that is, the frequency of AC is 50 Hz. An important advantage of AC over DC is that electric power can be transmitted over long distances without much loss of energy.

Social Science
Subject Code-087
Class - X (2026-27)

COURSE STRUCTURE

History (India and the Contemporary World-II)			**20 Marks inclusive of map pointing**
Section	**Chapter No.**	**Chapter name**	**Marks**
I Events and processes	I	The Rise of Nationalism in Europe	18+2 map pointing
	II	Nationalism in India	
II Livelihoods, Economies and Societies	III	The Making of a Global World (**To be evaluated in the Board Examination** Subtopics: 1 to 1.3 Pre Modern World to Conquest, disease and trade)	
		Interdisciplinary project as part of multiple assessments (Internally assessed for 5 marks) Subtopics 2 to 4.4 –The nineteenth century (1815-1914) to end of Bretton Woods & the beginning of "Globalisation"	
	IV	The Age of Industrialisation (**Tobe assessed as part of Periodic Assessment only**)	
III. Everyday Life, Culture and politics	V	Print Culture and the Modern world	
Geography (Contemporary India-II)			**Marks-20 inclusive map pointing**
Chapter No.	**Chapter Name**		**Marks**
1	Resources and Development		17+3 map pointing
2	Forest and Wildlife Resources		
3	Water resources		
4	Agriculture		
5	Minerals and energy Resources		
6	Manufacturing Industries		
7	Lifelines of National Economy (Only map pointing to be evaluated in the Board Examination)		

	Interdisciplinary project as part of multiple assessments (Internally assessed for 5 marks)		
Political Science (Democratic Politics-II)			**20**
Unit No.	**Chapter No.**	**Chapter name**	**Marks**
I	1	Power-sharing	20
	2	Federalism	
II	3	Gender, Religion and Caste	
III	4	Political Parties	
IV	5	Outcomes of Democracy	
Economics (Understanding Economic Development)			**20**
Chapter No.	**Chapter name**		**Marks**
1	Development		20
2	Sectors of the Indian Economy		
3	Money and Credit		
4	• Globalisation and the Indian Economy to be evaluated in the Board Examination • What is Globalisation? • Factors that have enabled Globalisation		
	• Interdisciplinary project as part of multiple assessment (Internally assessed for 5 marks) • Production across the countries • Chinese toys in India • World Trade Organisation • The Struggle for a Fair Globalisation		
5	Consumer Rights (Project Work)		

CLASS X (2026-27)
COURSE CONTENT

HISTORY: India and the Contemporary World - II

Chapter I -The Rise of Nationalism in Europe

Learning outcome- The students will be able to

- Infer how French Revolution had an impact on the European countries in the making of a nation state.
- Comprehend the nature of the diverse social movements of the time.
- Analyse and infer the evolution of the idea of nationalism which led to the formation of nation states in Europe and elsewhere.
- Evaluate the reasons which led to the First World War.

Chapter 2 Nationalism in India

Learning outcome- The students will be able to

- Illustrate various facets of Nationalistic movements that ushered in the sense of Collective Belonging.
- Evaluate the effectiveness of the strategies applied by Gandhiji and other leaders in the movements organised by him.
- Summarise the effects of the First World War that triggered the two defining movements (Khilafat &Non- Cooperation Movement) in India

Chapter 3-. The Making of a Global World

Subtopic 1. The pre-modern world
Subtopic 2. 19th century 1815 -1914
Subtopic 3. The inter- war economy
Subtopic 4. Rebuilding of world economy: the post war era.

Inter disciplinary Project with chapter 7 of Geography: Lifelines of National Economy and chapter 4 of Economics: Globalisation and the Indian Economy

Refer Annexure III B

Learning outcome- The students will be able to

- Summarise the changes that transformed the world in different areas.
- Depict the global interconnectedness from the Pre-modern to the present day.
- Enumerate the destructive impact of colonialism on the livelihoods of colonised people.

Chapter 4-The Age of Industrialisation

Learning outcome- The students will be able to

- Enumerate economic, political, social features of Pre and Post Industrialization.
- Analyse and infer how the industrialization impacted colonies with specific focus on India

Chapter 5. Print culture and the Modern World

Learning Outcome- The students will be able to

- Enumerate the development of Print from its beginnings in East Asia to its expansion in Europe and India.
- Compare and contrast the old tradition of handwritten manuscripts versus print technology.
- Summarise the role of Print revolution and its impact

Geography: Contemporary India – II

Chapter 1- Resources and Development

Learning Outcome- The students will be able to

- Enumerates how the resources are interdependent, justify how planning is essential in judicious utilisation of resources and the need to develop them in India.
- Infer the rationale for development of resources.
- Analyse and evaluate data and information related to non-optimal land, utilization in India
- Suggest remedial measures for optimal utilization of underutilized resources

Chapter 2- Forest and Wildlife Resources

Learning Outcome- The students will be able to

- Examine the importance of conserving forests and wildlife and their interdependency in maintaining the ecology for the sustainable development of India.
- Analyse the role of grazing and wood cutting in the development and degradation
- Summarise the reasons for conservation of biodiversity under sustainable development.
- Discuss how developmental works, grazing wood cutting have impacted the forests
- Use art integration to summarise and present the reasons for conservation of biodiversity in India under sustainable development.

Chapter 3-Water Resources

Learning Outcome- The students will be able to

- Examine the reasons for conservation of water resource in India.
- Analyse and infer how the multipurpose projects are supporting the requirement of water.

Chapter 4- Agriculture

Learning Outcome

- Examine the crucial role played by agriculture in our economy and society.
- Analyse the challenges faced by the farming community in India.
- Identifies various aspects of agriculture, including crop production, types of farming etc.

Chapter 5- Minerals and Energy Resources

Learning Outcome- The students will be able to

- Enumerate the impact of manufacturing industries on the environment and develop strategies for sustainable development of the manufacturing sector.
- Differentiate between various types of manufacturing industries based on their input materials, processes, and end products, and analyse their significance in the Indian economy.
- Analyse the relation between the availability of raw material and location of the industry

Chapter 6- Manufacturing Industries

Learning Outcome- The students will be able to

- Enumerates the impact of manufacturing industries on the environment and develop strategies for sustainable development of the sector.
- Differentiates between various types of manufacturing industries based on their input materials, processes, and end products, and analyse their significance in the Indian economy.

- Analyses the relation between the availability of raw material and location of the industry

Chapter 7- Life Lines of National Economy

Interdisciplinary project with chapter 3 of History: The making of a Global world and chapter 4 of Economics: Globalisation and the Indian Economy

Learning Outcome-Refer Annexure III-B

Political Science: Democratic Politics - II

Chapter 1- Power – sharing

Learning Outcome- The students will be able to

- Enumerate the need for power sharing in democracy.
- Analyse the challenges faced by countries like Belgium and Sri Lanka ensuring effective power sharing.
- Compare and contrast the power sharing of India with Sri Lanka and Belgium.
- Summarise the purpose of power sharing in preserving the unity and stability of a country

Chapter 2-Federalism

Learning Outcome- The students will be able to

- Infer how federalism is being practised in India.
- Analyse the policies and politics that has strengthened federalism in practice.

Chapter 3- Gender, Religion and Caste

Learning Outcome- The students will be able to

- Examine the role and differences of Gender, religion and Caste in practicing Democracy.
- Analyse that different expressions based on the differences, are healthy or otherwise in a democracy

Chapter 4- Political Parties

Learning Outcome- The students will be able to

- Understand the process of parties getting elected.
- Know the significance of the right to vote and exercise the duties as citizens of a nation.
- Examine the role, purpose and no. of Political Parties in Democracy.

Chapter 5- Outcomes of Democracy

Learning Outcome- The students will be able to

- Enumerates how the success of democracy depends on quality of government, economic well- being, inequality, social differences, conflict, freedom and dignity.

Economics: Understanding Economic Development

Chapter- 1. Development

Learning Outcome- The students will be able to

- Enumerate and examine the different processes involved in setting developmental Goals.
- Analyse and infer how the per capita income depicts the economic condition of the nation.
- Evaluate the development goals with reference to their efficacy, implemental strategies, relevance to current requirements of the nation.
- Compare the per capita income of some countries and infer reasons for the variance.
- Analyse the multiple perspectives on the need of development.

Chapter 2- Sectors of the Indian Economy

Learning Outcome- The students will be able to

- Analyse and infer how the economic activities in different sectors contribute to the overall growth and development of the Indian economy.
- Propose solutions to identified problems in different sectors based on their understanding.
- Summarise how the organised and unorganised sectors are providing employment
- Enumerate the role of the unorganised sector in impacting Per Capita Income currently and propose suggestive steps to reduce the unorganised sector for more productive contributions to GDP.
- Enumerate and infer the essential role of the Public and Private sectors

Chapter 3- Money and Credit

Learning Outcome- The students will be able to

- Enumerate how money plays as a medium exchange in all transactions of goods and services from ancient times to the present times.
- Analyse and infer various sources of Credit.
- Summarise the significance and role of self-help groups in the betterment of the economic condition of rural people/ women.

Chapter- 4. Globalisation and the Indian Economy

Subtopics: What is Globalisation?
Factors that have enabled Globalisation**.**

Interdisciplinary Project with chapter 3 of History: “The Making of a Global World” and chapter 7 of Geography: “Lifelines of National Economy”

Subtopics:

i. Production across the countries
ii. World Trade Organisation
iii. The Struggle for a Fair Globalisation

Refer Annexure III-B

Learning Outcome- The students will be able to

- Enumerate the concept of globalisation and its definition, evolution, and impact on the global economy.
- Evaluate the key role of the key major drivers of globalisation and their role in shaping the global economic landscape in various countries.
- Comprehend the significance of role of G20 and its significance in the light of India's role.

5. Project work - Consumer Rights **OR** Social Issues **OR** Sustainable Development

Learning Outcome- Refer Annexure III

CLASS X (2025-26)
MAP WORK

<table>
<tr><th>Subject</th><th>Name of the Chapter</th><th>List of areas to be located/ labeled/ identified on the map</th></tr>
<tr><td>History</td><td>Nationalism in India</td><td>I. Congress sessions:
• 1920 Calcutta
• 1920 Nagpur
• 1927 Madras session
II. 3 Satyagraha movements:
• Kheda
• Champaran
• Ahmedabad mill workers
III. Jallianwala Bagh
IV. Dandi March</td></tr>
<tr><td>Geography</td><td>Resources and Development</td><td>Identify Major Soil Types</td></tr>
<tr><td rowspan="3"></td><td>Water Resources</td><td>Locating and Labeling:
• Salal
• Bhakra Nangal
• Tehri
• Rana Pratap Sagar
❑ Sardar Sarovar
❑ Hirakund
❑ Nagarjun Sagar
❑ Tungabhadra</td></tr>
<tr><td>Agriculture</td><td>Identify:
• Major areas of Rice and Wheat
• Largest/Major producer states of Sugarcane, Tea, Coffee,
• Rubber, Cotton and Jute</td></tr>
<tr><td>Minerals and Energy Resources</td><td>Identify:
Iron Ore Mines
Mayurbhanj
Durg
Bailadila
Bellary
Kudremukh
Coal Mines
Raniganj
Bokaro
Talcher
Neyveli
Oil Fields
Digboi Naharkatia
Mumbai High
Bassien
Kalol
Ankaleshwar</td></tr>
</table>

<table>
<tr><td></td><td></td><td>Locate and label: Power Plants<table><tr><th>Thermal</th><th>Nuclear</th></tr><tr><td>• Namrup
• Singrauli
• Ramagundam</td><td>• Narora
• Kakrapara
• Tarapur
• Kalpakkam</td></tr></table></td></tr>
<tr><td></td><td>Manufacturing Industries</td><td>• Manufacturing Industries (Locating and labeling only)
• Cotton textile Industries: a. Mumbai, b. Indore, c. Surat, d. Kanpur, e. Coimbatore
• Iron and Steel Plants: a. Durgapur, b. Bokaro, c. Jamshedpur, d. Bhilai, e. Vijayanagar, f. Salem
• Software technology Parks: a. Noida, b. Gandhi- nagar, c. Mumbai, d. Pune, e. Hyderabad, f. Bengaluru, g. Chennai,h. Thiruvananthapuram</td></tr>
<tr><td></td><td>Lifelines of National Economy</td><td>Locating and Labeling
a. Major Sea Ports<table><tr><td>• Kandla
• Mumbai
• Marmagao
• New Mangalore
• Kochi</td><td>• Tuticorin
• Chennai
• Visakhapatnam
• Paradip
• Haldia</td></tr></table>b. International Airports
• Amritsar (Raja Sansi-Sri Guru Ram Das ji)
• Delhi (Indira Gandhi)
• Mumbai (Chhatrapati Shivaji)
• Chennai (Meenambakkam)
• Kolkata (Netaji Subhash Chandra Bose)
• Hyderabad (Rajiv Gandhi)</td></tr>
</table>

Note

1. Items of Locating and Labelling may also be given for Identification.
2. The Maps available in the website of Govt. of India may be used.

CLASS X
QUESTION PAPER DESIGN

Subject Wise Weightage

Subject	Syllabus	Marks (80)	Percentage
History	• The Rise of Nationalism in Europe. • Nationalism in India: • The Making of a Global World Sub topics 1 to 1.3 • Print Culture and the Modern World • Map pointing	18+2	25%
Political Science	• Power – sharing • Federalism • Gender, Religion and Caste • Political Parties • Outcomes of Democracy	20	25%
Geography	• Resources and Development • Forest and Wildlife Resources • Water Resources • Agriculture • Mineral& Energy resources • Manufacturing industries. • Lifelines of National Economy (map pointing) • Map pointing	17+3	25%
Economics	• Development • Sectors of the Indian Economy • Money and Credit • Globalisation and The Indian Economy Sub topics: ➢ What is Globalisation? ➢ Factors that have enabled Globalisation	20	25%

Weightage to Type of Questions

Type of Questions	Marks (80)	Percentage
1 Mark- MCQs (20x1) (Inclusive Of Assertion, Reason, Differentiation & Stem)	20	25%
2 Marks- Long Answer Questions (4x2) (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis & Create)	8	10%
3 Marks- Long Answer Questions (5x3) (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis & Create)	15	18.75%
4 Marks- Case Study Questions (3x4) (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis & Create)	12	15%
5 Mark- Long Answer Questions (4x5) (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis & Create)	20	25%
Map Pointing	5	6.25%

Weightage to Competency Levels

Sr. No.	Competencies	Marks (80)	Percentage
1	**Remembering and Understanding**: Exhibiting memory of previously learned material by recalling facts, terms, basic concepts, and answers; Demonstrating understanding of facts and ideas by organizing, translating, interpreting, giving descriptions and stating main ideas.	24	30%
2	**Applying**: Solving problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	11	13.25%
3	**Analysing, Evaluating and Creating**: Examining and breaking information into parts by identifying motives or causes; Making inferences and finding evidence to support generalizations; Presenting and defending opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. Compiling information together in a different way by combining elements in a new pattern or proposing alternative solutions.	40	50%
4	Map Skill	5	6.25%
	Total	**80**	**100%**

CLASS X (2026-27)

GUIDELINES FOR INTERNAL ASSESSMENT: 20 MARKS

Type of Assessment	Description	Marks
Periodic Assessment	Pen Paper Test.	**5**
Multiple Assessment	Quiz, debate, role play, viva, group discussion, visual expression, interactive bulletin boards, gallery walks, exit cards, concept maps, peer assessment, Self-assessment etc. through Interdisciplinary project	**5**
Subject Enrichment Activity	Project Work on Consumer Rights OR Social Issues OR Sustainable Development (Interdisciplinary)	**5**
Portfolio	Classwork, Work done (activities/ assignments) reflections, narrations, journals, etc. Achievements of the student in the subject throughout the year Participation of the student in different activities like heritage India quiz	**5**

CLASS X
PRESCRIBED TEXTBOOKS

S.No.	Subject	Name of the Book	Publisher
1	History	India and the Contemporary World-II	NCERT
2	Political Science	Democratic Politics-II	NCERT
3	Geography	Contemporary India-II	NCERT
4	Economics	Understanding Economic Development	NCERT
5	Disaster Management	Together, towards a safer India- Part III	CBSE

Interdisciplinary Project: Class X

Subject and Chapter No.	Name of the Chapter	Suggested Teaching Learning Process	Learning Outcomes with Specific Competencies	Time Schedule For Completion
History Chapter III Geography Chapter 7	Making of a Global World Lifelines of National Economy	The teachers may use the following pedagogies in facilitating the students in completion of Interdisciplinary Project. 1) Constructivism 2) Inquiry based learning 3) Cooperative learning 4) Learning station 5) Collaborative learning 6) Videos/ Visuals/ documentaries/ movie clippings 7) Carousel technique 8) Art integrated learning Group Discussions Multiple Assessment: Ex. Surveys/ Interviews/ Research work/ Observation/ Story based	➢ Analyse the implication of globalisation for local economies. ➢ Discuss how globalisation is experienced differently by different social groups. Enumerates how transportation works as a lifeline of the economy. ➢ Analyse and infer the impact of roadways and railways on the national economy. ➢ Analyses and infers the challenges faced by the roadways and railway sector in India	The schools do IDP between the months of April and September at the School under the guidance of a teacher. (Carryover of project to home must be strictly avoided)
Economics Chapter 4	Globalisation on and the Indian Economy	Presentation/ Art integration/ Quiz/ Debate/ role play/ viva, /group discussion, /visual expression/ interactive bulletin boards/ gallery walks/ exit cards/ concept maps/ peer assessment/ art integration /Self - assessment/integration of technology etc.	➢ Integrate various dimensions of globalisation in terms of cultural / political/ social /economic aspects) ➢ Appraise the evolution of Globalisation and the global trends ➢ Investigate the factors that facilitated the growth on MNC ‘s	

Guidelines:

- It involves combining 2 or more disciplines into one activity-more coherent and integrated. The generally recognized disciplines are economics, History, Geography, Political Science, a sample plan has been enclosed) Kindly access the link given below

- Methodology (A sample interdisciplinary project plan Link has been provided to get an insight about IDP.
- Topic: The Making of a Global World, Globalisation and Lifelines of Economy

  https://docs.google.com/document/d/1dIwwFeaSrExJHMtkzcEuoq3ehh-7FtHM/edit

Plan of the project:
A suggestive 10 days' plan given below which you may follow, or you can create on your own, based on the templates provided below

Process:
Initial collaboration among students to arrange their roles, areas of integration, area of investigation and analysis, roles of students

Class X: 10-day Suggestive plan for Interdisciplinary Project
Day 1: Introduction to the Interdisciplinary Project and Setting the Context:
Brief overview of the project and its objectives to be given by the teachers. History teacher to Introduce the historical context of World War II and its aftermath through inquiry methods. Make the students to Group discuss the impact of World War II on the global economy. Teacher to refer annexure III for rubrics) **Day 2: The Great Depression:** Students to watch a video from the link, https://www.youtube.com/watch?v=62DxELjuRec and https://www.youtube.com/watch?v=gqx2E5qIV9s and discuss the causes and consequences of the Great Depression and the role of mass production and consumption in the Great Depression. Present a group PPT /report on consequences of the Great Depression on the global economy. **Day 3: India and the Great Depression:** Students to collect material related to India's economic condition during the Great Depression and relate it to the present economic condition of India and US. Students may collect information through a visit to the library. As a group activity they need to present a collage of their findings. (Refer Annexure V for Rubrics) **Day 4: Rebuilding the World Economy and Interlinking Production across countries** • Teachers to use Jigsaw method to make the students to sit in groups and to give each group a part of the handout with information about process taken to rebuild economy and how the production across countries got interlinked. Make the groups to compile the information by moving from group to group. • Make them discuss the post-war recovery efforts and their impact on the global economy • Study the role of the Bretton Woods Institutions in rebuilding the world economy and present their learnings through Art Integrated Project. Refer Annexure V for rubrics.

Day 5: The Early Post-War Years: The role of roadways, railways, waterways and airways in building the national economy

- The teacher distributes the Handout 1 given below to the groups and asks them to find answers to the questions posed at the end of Hand out and present it in groups using Café conversations mode. Refer Annexure III for rubrics.
- Study the challenges faced by the world in the early post-war years

Day 6: Post war settlement and Bretton Woods institutions

- Make the students read the material available online/in library and debate the impact of Bretton Woods institutions in the post war economy. Refer Annexure V for Rubrics.

Day 7: Decolonization and Independence - The Role of World Trade Organization:

- The students will read the handout 2 given below and present a role play of the support rendered by the World Trade Organisation in building new nations. Refer Annexure V for rubrics
- Introduction to the World Trade Organization
- Study the role of the WTO in promoting fair trade practices
- Discuss the efforts made towards decolonization and independence of nations

Day 8: End of Bretton Woods and the Beginning of Globalisation:

- The students will read material given in the link https://www.imf.org/external/about/histend.htm#:~:text=End%20of%20Bretton% 20Woods%20system,-The%20system%20 dissolved&text=In% 20August% 201971 %2C%20U.S.%20Pr esident,the%20breakdown%20of%20the%20syste m.
- Organise an interview with a financial expert/economist/ lecturer/professor. Based on the information they gathered, the students can submit a report on the findings.
- Discuss the reasons for the end of the Bretton Woods system

Day 9: Impact of Globalization in India and role of waterways and airways https://www.jagranjosh.com/general-knowledge/new-economic-policy-of-1991-objectives-features-and-impacts-1448348633-1

- The students will read the material given in the above link and design a report on what would have happened to India if this stand wasn't taken and present it as a radio talk show. They will link the role of waterways and airways in the achievement of India in globalisation.
- Study the impact of globalisation on the Indian economy
- Discuss the challenges faced by India in the process of globalisation

Day 10. Final presentation

Conclude the interdisciplinary project and summarize the key takeaways.

Handout 1 for Day 4 of Inter Disciplinary Project of Class X

Title: The Role of Waterways and Airways in Post-World War II- World and India

Introduction: After the end of World War II, the world faced significant economic, social, and political changes. The role of waterways and airways in shaping the post-war world and India is crucial to understand. In this handout, we will discuss the impact of waterways and airways on the global economy and how it helped India in its development.

Waterways: In the post-World War II era, waterways played a crucial role in the movement of goods and people. The improvement of ports and waterways allowed for more efficient transportation of goods and helped to spur economic growth.

The increased demand for goods and services, combined with the development of shipping technologies, allowed for the expansion of international trade. This helped to boost the world economy and allowed for the growth of industries in many countries, including India.

In India, the development of waterways and ports helped to improve the country's economy. The country's long coastline and several rivers made it an ideal location for the transportation of goods. The growth of ports and waterways in India allowed for the movement of goods from one part of the country to another, helping to spur economic growth and development.

Airways: After World War II, the development of air transportation revolutionized the world's economy. The expansion of air travel allowed for faster and more efficient transportation of goods and people, which helped to boost the world economy.

In India, the growth of airways helped to connect different parts of the country and made it easier for people and goods to move from one place to another. This helped to spur economic growth and development in India.

The growth of air transportation in India also allowed for the expansion of international trade. Indian businesses could now easily access foreign markets, which helped to boost the country's economy.

Conclusion:

The role of waterways and airways in the post-World War II world and India was crucial in shaping the economic and social landscape of these countries. The development of these transportation modes helped to spur economic growth and allowed for the expansion of international trade. Understanding the impact of waterways and airways on the world and India is crucial in understanding the economic and social changes that took place after World War II.

Questions:

1. Mention the role of major ports in imports and exports.
2. Emergence of Deccan airways changed the entire functionalities of domestic airways. Substantiate the statement
3. The waterways and airways contribute to the economic growth of India. Substantiate your answer.

Handout 2 for day 7 of Inter Disciplinary Project of Class X

Title The Role of the World Trade Organization (WTO) in Building New Nations Post-Colonialization

Introduction: After the end of colonialism, many countries faced significant economic and political challenges as they worked to establish themselves as independent nations. The World Trade Organization (WTO) played a crucial role in helping these countries to rebuild their economies and participate in the global economy. In this handout, we will discuss the role of the WTO in building new nations post- colonialization.

What is the WTO?

The WTO is an international organization that was established in 1995 to promote international trade and help countries participate in the global economy.

The WTO provides a forum for countries to negotiate and enforce international trade agreements and helps to ensure that trade is conducted in a fair and predictable manner. The organization also provides technical assistance and advice to help countries improve their trade policies and participate in the global economy.

How has the WTO helped new nations post-colonialization?

After colonial rule ended, many countries faced significant economic challenges as they worked to establish themselves as independent nations. The WTO helped these countries to participate in the global economy by providing a forum for trade negotiations and by helping to enforce international trade agreements.

The WTO also provided technical assistance and advice to help these countries improve their trade policies and participate in the global economy. This helped to spur economic growth and development in these countries and allowed them to become more integrated into the global economy.

By participating in the global economy, new nations post-colonialisation was able to expand their markets, attract foreign investment, and improve their economic performance. The WTO played a crucial role in helping these countries to build their economies and establish themselves as stable, independent nations.

Conclusion:

The WTO played a crucial role in building new nations post-colonialization by helping these countries to participate in the global economy. The organization's trade negotiations, enforcement of international trade agreements, and technical assistance helped to spur economic growth and development in these countries. Understanding the role of the WTO in building new nations post-colonialization is important in understanding the economic and political changes that took place after the end of colonial rule.

ANNEXURE IV

Suggested Template for Presentation by the Students

Name of the Students (Team):	
Class :	**Section:**
Topics of Interdisciplinary Project:	
Title of the Project:	
Objectives:	
Multiple Assessment: Ex. Surveys / Interviews / Research work/ Observation/ Story based Presentation/ Art integration/ Quiz/ Debate/ role play/ viva, /Group discussion /visual expression/ interactive bulletin boards/ gallery walks/ exit cards/ concept maps/ peer assessment/ art integration /Self-assessment/ integration of technology etc.	
Evidences: Photos, Excerpts from Interviews, observations, Videos, Research References, etc.	
Overall presentation: Link of PPT, shared documents, can be digital/handwritten, as per the convenience of the school.	
Acknowledgement:	
References **(websites, books, newspaper etc.)**	
Reflections:	

ANNEXURE V

Rubrics for Interdisciplinary Project

Rubrics	Marks allocated
Research Work	1
Collaboration & Communication	1
Presentation & Content relevance	1
Competencies- Creativity, Analytical skills, Evaluation, Synthesizing,	2
Total	**5**

CBSE | DEPARTMENT OF SKILL EDUCATION

CURRICULUM FOR SESSION 2026-2027

ARTIFICIAL INTELLIGENCE (SUB. CODE 417)
CLASS – X

OBJECTIVES OF THE COURSE:

The objective of this module/curriculum - which combines both Inspire and Acquire modules is to develop a readiness for understanding and appreciating Artificial Intelligence and its application in our lives. This module/curriculum focuses on:

1. Helping learners understand the world of Artificial Intelligence and its applications through games, activities and multi-sensorial learning to become AI-Ready.
2. Introducing the learners to three domains of AI in an age-appropriate manner.
3. Allowing the learners to construct the meaning of AI through interactive participation and engaging hands-on activities.
4. Introducing the learners to the AI Project Cycle.
5. Introducing the learners to programming skills - Basic python coding language.
6. To equip students with the skills to develop AI solutions addressing societal challenges.

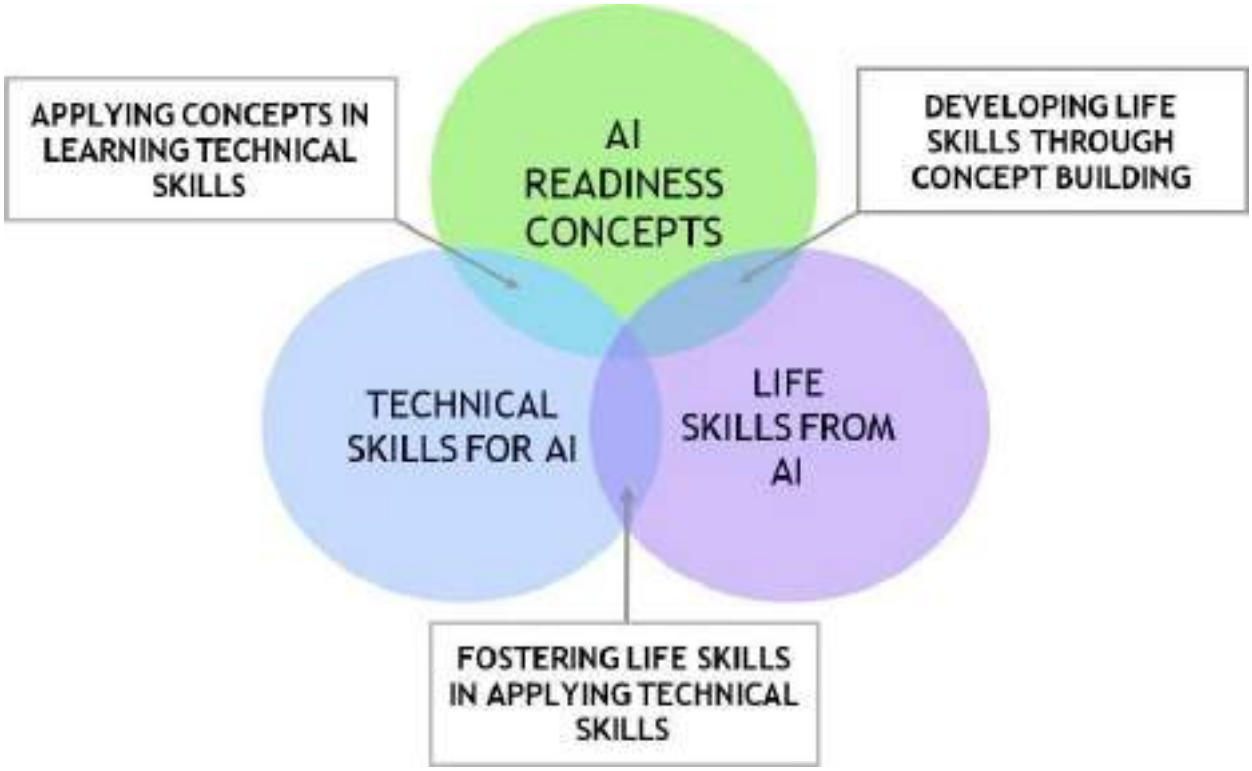
LEARNING OUTCOMES:

Learners will be able to

1. Identify and appreciate Artificial Intelligence and describe its applications in daily life.
2. Relate, apply and reflect on the Human-Machine Interactions to identify and interact with the three domains of AI: Data, Computer Vision and Natural Language Processing and Undergo assessment for analysing their progress towards acquired AI-Readiness skills.
3. Imagine, examine and reflect on the skills required for futuristic job opportunities.
4. Unleash their imagination towards smart homes and build an interactive story around it.
5. Understand the impact of Artificial Intelligence on Sustainable Development Goals to develop responsible citizenship.
6. Research and develop awareness of skills required for jobs of the future.
7. Gain awareness about AI bias and AI access and describe the potential ethical considerations of AI.
8. Develop effective communication and collaborative work skills.
9. Get familiar and motivated towards Artificial Intelligence and Identify the AI Project Cycle framework.
10. Learn problem scoping and ways to set goals for an AI project and understand the iterative nature of problem scoping in the AI project cycle.
11. Brainstorm on the ethical issues involved around the problem selected.

12. Foresee the kind of data required and the kind of analysis to be done, identify data requirements and find reliable sources to obtain relevant data.
13. Use various types of graphs to visualize acquired data.
14. Understand, create and implement the concept of Decision Trees.
15. Understand and visualize the computer's ability to identify alphabets and handwriting.
16. Understand and appreciate the concept of domains through gamification and learn basic programming skills through gamified platforms.
17. Acquire introductory Python programming skills in a very user-friendly format.
18. Empower students to create positive change through AI-driven social impact projects.

SKILLS TO BE DEVELOPED:



SCHEME OF STUDIES:

This course is a planned sequence of instructions consisting of units meant for developing employability and vocational competencies of students of Class X opting for skill subjects along with other education subjects.

The unit-wise distribution of hours and marks for class X is as follows:

CBSE | DEPARTMENT OF SKILL EDUCATION

ARTIFICIAL INTELLIGENCE (SUBJECT CODE 417) CLASS – X (SESSION 2026-2027)

Total Marks: 100 (Theory-50 + Practical-50)

	UNITS	NO. OF HOURS for Theory and Practical		MAX. MARKS for Theory and Practical
PART A	**Employability Skills**			
	Unit 1: Communication Skills-II	10		2
	Unit 2: Self-Management Skills-II	10		2
	Unit 3: ICT Skills-II	10		2
	Unit 4: Entrepreneurial Skills-II	10		2
	Unit 5: Green Skills-II	10		2
	Total	**50**		**10**
PART B	**Subject Specific Skills**	**Theory (hours)**	**Practical (hours)**	**Marks**
	Unit 1: Revisiting AI Project Cycle & Ethical Frameworks for AI	11	4	7
	Unit 2: Advanced Concepts of Modeling in AI	18	7	11
	Unit 3: Evaluating Models	21	4	10
	Unit 4: Statistical Data	–	28	–
	Unit 5: Computer Vision	10	20	4
	Unit 6: Natural Language Processing	20	7	8
	Unit 7: Advance Python		10	–
	Total	**160**		**40**
PART C	**Practical & Project Work:**			**Marks**
	Practical File with minimum 15 Programs			15
	Practical Examination ● Unit 4: Statistical Data ● Unit 5: Computer Vision ● Unit 6: Natural Language Processing ● Unit 7: Advance Python			15
	Viva Voce			5
	Project Work / Field Visit / Student Portfolio (Anyone to be done)			10
	Viva Voce (related to project work)			5
	Total			**50**
	GRAND TOTAL	**210**		**100**

DETAILED CURRICULUM/TOPICS FOR CLASS X

Part-A: EMPLOYABILITY SKILLS

S. No.	Units	Duration in Hours
1.	Unit 1: Communication Skills-II	10
2.	Unit 2: Self-management Skills-II	10
3.	Unit 3: Information and Communication Technology Skills-II	10
4.	Unit 4: Entrepreneurial Skills-II	10
5.	Unit 5: Green Skills-II	10
	TOTAL	**50**

Note: The detailed curriculum/ topics to be covered under Part A: Employability Skills can be downloaded from CBSE website

Part-B – SUBJECT SPECIFIC SKILLS

- Unit 1: Revisiting AI Project Cycle & Ethical Frameworks for AI
- Unit 2: Advanced Concepts of Modeling in AI
- Unit 3: Evaluating Models
- Unit 4: Statistical Data
- Unit 5: Computer Vision
- Unit 6: Natural Language Processing
- Unit 7: Advance Python

UNIT 1: Revisiting AI Project Cycle & Ethical Frameworks for AI

SUB-UNIT	LEARNING OUTCOMES	ACTIVITY/ PRACTICAL
AI Project Cycle	Understand the stages of the AI Project Cycle.	**Session:** Revisiting AI Project Cycle
Introduction to AI Domains	Understand the concept of Artificial Intelligence (AI) domains and the illustrations of practical applications within each AI domain.	**Session**: The three domains of AI and their applications.

SUB-UNIT	LEARNING OUTCOMES	ACTIVITY/ PRACTICAL
Ethical Frameworks of AI	Learn about the ethical framework for AI and its category. Explore Bioethics, a popular framework that is used in the healthcare industry.	**Session**: Frameworks, Ethical Framework and need of Ethical Frameworks for AI. Activity: My Goodness https://www.my-goodness.net/
		Session: Types of Ethical Frameworks.
		Session: Bioethics and a case study in bioethics.

UNIT 2: Advance Concepts of Modeling in AI

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Revisiting AI, ML, DL	Understand AI, ML and DL	**Session:** Differentiate between AI, ML, and DL **Session:** Common terminologies used with data
Modeling	• Familiarize with supervised, unsupervised and reinforcement learning based approach • Understand subcategories of Supervised, Unsupervised and deep learning models	**Session:** Types of AI Models: Rule Based Approach, Learning Based Approach **Session:** Categories of Machine learning based models: Supervised Learning (https://teachablemachine.withgoogle.com/), Unsupervised Learning (https://experiments.withgoogle.com/ai/drum-machine/view/), Reinforcement Learning **Session:** Subcategories of Supervised Learning Model: Classification Model, Regression Model **Session:** Subcategories of Unsupervised Learning Model: Clustering, Association **Session:** Subcategories of Deep Learning: Artificial Neural networks (ANN), Convolutional Neural Network (CNN)
Artificial Neural Networks	• Understand Neural Networks • Understand how AI makes a decision	**Session:** What is Neural Network? **Session:** How does AI make a Decision? **Activity:** Human Neural Network – The Game **Suggested Neural Network Activity:** https://playground.tensorflow.org/

UNIT 3: Evaluating Models

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Importance of Model Evaluation	Understand the role of evaluation in the development and implementation of AI systems.	**Session:** What is evaluation? **Session:** Need of model evaluation

Splitting the training set data for Evaluation	Understand Train-test split method for evaluating the performance of a machine learning algorithm	**Session:** Train-test split
Accuracy and Error	Understand Accuracy and Error for effectively evaluating and improving AI models	**Session:** Accuracy **Session:** Error **Activity:** Find the accuracy of the AI model
Evaluation metrics for classification	Learn about the different types of evaluation techniques in AI, such as Accuracy, Precision, Recall and F1 Score, and their significance.	**Session:** What is Classification? **Session:** Classification metrics **Activity:** Build the confusion matrix from scratch **Activity:** Calculate the accuracy of the classifier model **Activity:** Decide the appropriate metric to evaluate the AI model
Ethical concerns around model evaluation	Understand ethical concerns around model evaluation	**Session:** Bias, Transparency, Accuracy

UNIT 4: Statistical Data (To be assessed through Practicals)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Introduction & No code AI tool	Define the concept of Statistical Data and understand its applications in various fields. Define No-Code and Low-Code AI. Identify the differences between Code and No-Code AI concerning Statistical Data.	**Session: No code AI tool** •Introduction to Data Science & its applications •Meaning of No-Code AI • No-Code and Low-Code. • Some no-code tools **Orange Data Mining Tool:** **https://orangedatamining.com/download/**
Statistical Data: Use Case Walk through	Relate AI project stages to the stages of No-Code AI projects Able to use no-code tool Orange Data mining. To perform data exploration, modeling and evaluation with Orange data mining.	**Session** •Important concepts in Statistics. • Orange data mining • AI project cycle in Orange data mining (Palmer penguins case study) **Activity:** MS Excel for Statistical Analysis. Link:**https://docs.google.com/spreadsheets/d/1f5G-JXyP7EV2fy1hax47YVaH5gyq8KZy/edit?usp=drive_link&ouid=109928090180926267402&rtpof=true&sd=true** Case study using Orange data mining (Palmer Penguins). Link: https://drive.google.com/drive/u/0/folders/1fmcRVb-ilTyUhmUv4DWT1BFsaCoQ2BmF

UNIT 5: Computer Vision (To be assessed through Theory)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Introduction	Define the concept of Computer Vision and understand its applications in various fields.	**Session:** Introduction to Computer Vision
		Session: Applications of CV
Concepts of Computer Vision	Understand the basic concepts of image representation, feature extraction, object detection, and segmentation.	**Session:** Understanding CV Concepts ● Computer Vision Tasks ● Basics of Images-Pixel, Resolution, Pixel value ● Grayscale and RGB images
		Activities: ● Game- Emoji Scavenger Hunt https://emojiscavengerhunt.withgoogle.com/ ● RGB Calculator: https://www.w3schools.com/colors/colors_rgb.asp ● Create your own pixel art: www.piskelapp.com ● Create your own convolutions: http://setosa.io/ev/image-kernels/

UNIT 5: Computer Vision (To be assessed through Practicals)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
No-Code AI Tools	To demonstrate proficiency in using no-code AI tools for computer vision projects. To deploy models, fine-tune parameters, and interpret results. Skills acquired include data preprocessing, model selection, and project deployment.	**Introduction to Lobe: https://www.lobe.ai/** **Teachable Machine: https://teachablemachine.withgoogle.com/** • **Activity:** Build a Smart Sorter **Orange Data Mining Tool: https://orangedatamining.com/download/** • **Activity:** Build a real-world Classification Model: Coral Bleaching (Use Case Walkthrough) • Link to the steps involved in project development and dataset: https://drive.google.com/drive/folders/1ppJ4d-8yOFJ2G22rHHpjNrK0ejdIAe5Q?usp=sharing
Image Features & Convolution Operator	Apply the convolution operator to process images and extract useful features.	**Session:** Understanding Convolution operator
		Activity: Convolution Operator
Convolution Neural Network	Understand the basic architecture of a CNN and its applications in computer vision and image recognition.	**Session:** Introduction to CNN
		Session: Understanding CNN ● Kernel ● Layers of CNN
		Activity: Testing CNN

UNIT 6: Natural Language Processing (To be assessed through Theory)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Introduction	Comprehend the complexities of natural languages. and elaborate on the need for NLP techniques for machines to understand various natural languages effectively.	**Session:** Features of natural languages. **Session:** Introduction to Natural Language Processing
Applications of Natural Language Processing	Explore the various applications of NLP in everyday life, such as , voice assistants, auto generated captions, language translation, sentiment analysis, text classification and keyword extraction.	**Session:** Various real-life applications of NLP **Activity:** Keyword Extraction https://cloud.google.com/natural-language
Stages of Natural Language Processing (NLP)	Understand the concepts like lexicon, syntax, semantics, and logical analysis of input text.	**Session:** Explore the various stages of NLP that involve in understanding and processing human language.
Chatbots	Understand the concept of chatbot and the differences between smartbots and script bots.	**Activity:** Play with chatbots Elizabot - https://www.masswerk.at/elizabot/ Mitsuki - https://www.kuki.ai/ Cleverbot - https://www.cleverbot.com/ Singtel - https://www.singtel.com/personal/support **Session:** Script Bot V/s Smart Bot
Concepts of Natural Language Processing: Text Processing	Learn about the Text Normalization technique used in NLP and the popular NLP model - Bag-of-Words	**Session: Text Processing** • Text Normalisation • Bag of Words **Hands-on:** Text processing • Data Processing • Bag of Words • TFIDF

UNIT 6: Natural Language Processing (To be assessed through Practicals)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Natural Language Processing: Use Case Walkthrough	Explore the sentiment analysis process using real-life datasets with the Orange Data Mining tool.	**Session:** Examples of Code and No-code NLP Tools **Session:** Applications of NLP- Introduction to Sentiment Analysis
		Hands-on: Case Walkthrough – Steps involved in project development Link to steps and dataset: https://drive.google.com/drive/u/2/folders/1geFLXxV5890kfcakMfEg_KsH1LPcS_Iz

UNIT 7: ADVANCE PYTHON (To be assessed through Practicals)

SUB-UNIT	LEARNING OUTCOMES	SESSION/ ACTIVITY/ PRACTICAL
Recap	Understand to work with Jupyter Notebook, creating virtual environments, installing Python Packages.	**Session:** Jupyter Notebook
	Able to write basic Python programs using fundamental concepts such as variables, data types, operators, and control structures.	**Session:** Introduction to Python
	Able to use Python built-in functions and libraries.	**Session:** Python Basics

PART-C: PRACTICAL & PROJECT WORK

Practical Work:

Suggested Programs List	• Write a program to add the elements of the two lists. • Write a program to calculate mean, median and mode using Numpy • Write a program to display line chart from (2,5) to (9,10). • Write a program to display a scatter chart for the following points (2,5), (9,10),(8,3),(5,7),(6,18). • Read the csv file saved in your system and display 10 rows. • Read csv file saved in your system and display its information • Write a program to read an image and display using Python • Write a program to read an image and identify its shape using Python
Important Links	Link to AI Activities & steps to AI project development considering real life problem statement along with the required dataset https://docs.google.com/spreadsheets/d/1ZQCTT8RM-l7QfeTzH0n-5wJLBAoiXu7TFM0Pcp31cX0/edit?usp=sharing
Project Work / Field Visit / Student Portfolio *** relate it to Sustainable Development Goals** **Suggested Projects/ Field Visit / Portfolio (any one activity to be one)**	
Sample Projects	AI Project Development Using 1. Statistical Data for AI: Prediction of palmer penguin species 2. Computer Vision: Early detection of coral bleaching 3. Natural Language Processing: Sentiment Analysis
Field Work	Students' participation in the following- • AI for Youth Bootcamp • AI Fests/ Exhibition • Participation in any AI training sessions • Virtual tours of companies using AI to get acquainted with real-life usage
Student Portfolio (to be continued from class IX)	• Maintaining a record of all AI activities • Hackathons • Competitions (CBSE/Inter School) Note: Portfolio should contain minimum 5 activities

LIST OF ITEMS/ EQUIPMENT'S (MINIMUM REQUIREMENTS):

The equipment / materials listed below are required to conduct effective hands-on learning sessions while delivering the AI curriculum to class 10 students. The list below consists of minimal configuration required to execute the AI curriculum for class 10 and create social impact real time solutions/ projects. The quantities mentioned here are recommended for a batch of 20 students keeping the human-machine ratio as 2:1. An exhaustive list may be compiled by the teacher(s) teaching the subject.

S. NO.	ITEM NAME, DESCRIPTION & SPECIFICATION
A	**SYSTEM SPECIFICATIONS**
1	Processor: Intel® Core™ i5-7300U Processor or equivalent with minimum SYSmark® 2018 Rating of 750 or higher
2	Graphic Card: Integrated graphics
3	Form Factor: - USFF (Ultra Small Form factor) System chassis volume less than One Litre
4	RAM: 8GB DDR4 – 2400MHz or above
5	Storage: 500 GB HDD – 7200 rpm
6	Display: 18.5" LED Monitor with HDMI, in-built-speaker,
7	Keyboard: Keyboard with numerical keypad (recommended)
8	Mouse: Optical Mouse
9	Webcam: Full HD Camera
10	Headphones with Mic
11	Dual Band Wireless Connectivity Min 800 Mbps
12	Bluetooth V4.2 or Higher
13	Ports: 4 USB 3.0 ports, dual high-definition display ports (HDMI 2.0/DP/thunderbolt 3.0 ports), High definition 8-channel audio through HDMI interface or through audio jack.
14	VPU: - Integrated or support for VPU - vision processing unit to accelerate AI machine vision applications.
B	**SOFTWARE SPECIFICATIONS**
1	Operating System: Any
2	Anti-Virus Activated
3	Internet Browser: Google Chrome
4	Productivity Suite: Any (Google+ Suite recommended)
5	Anaconda Navigator Distribution (https://bit.ly/AI-installation-guide)
6	Conceptual installations (https://bit.ly/AI-installation-guide)
7	Intel Open VINO tools
8	Python

NOTE: In keeping with the spirit of Recycle, Upcycle and Reuse, it is recommended to make use of any equipment/ devices/ accessories from the existing inventory in school.

TEACHER'S/ TRAINER'S QUALIFICATIONS:

Qualification and other requirements for appointment of teachers/trainers for teaching this subject, on contractual basis should be decided by the State/ UT. The suggestive qualifications and minimum competencies for the teacher should be as follows:

Qualification	Minimum Competencies	Age Limit
Diploma in Computer Science/ Information Technology **OR** Bachelor's Degree in Computer Applications/Science/Information Technology (BCA, B.Sc. Computer Science/ Information Technology) **OR** Graduate with PGDCA **OR** DOEACC A Level Certificate. *The suggested qualification is the minimum criteria. However higher qualifications will also be acceptable.*	● The candidate should have a minimum of 1 year of work experience in the same job role. ● S/He should be able to communicate in English and local language. ● S/He should have knowledge of equipment, tools, material, Safety, Health & Hygiene.	● 18-37 years (as on Jan. 01 (year)) ● Age relaxation to be provided as per Govt. rules

Teachers/Trainers form the backbone of Skill (Vocational) Education being imparted as an integral part of Rashtriya Madhyamik Shiksha *Abhiyan* (RMSA). They are directly involved in teaching of Skill (vocational) subjects and also serve as a link between the industry and the schools for arranging industry visits, On-the-Job Training (OJT) and placement.

These guidelines have been prepared with an aim to help and guide the States in engaging quality Teachers/Trainers in the schools. Various parameters that need to be looked into while engaging the Vocational Teachers/Trainers are mode and procedure of selection of Teachers/ Trainers, Educational Qualifications, Industry Experience, and Certification/ Accreditation.

The State may engage Teachers/Trainers in schools approved under the component of scheme of Vocationalisation of Secondary and Higher Secondary Education under RMSA in following ways:

(i) Directly as per the prescribed qualifications and industry experience suggested by the PSS Central Institute of Vocational Education (PSSCIVE), NCERT or the respective Sector Skill Council (SSC).

OR

(ii) Through accredited Vocational Training Providers accredited under the National Quality Assurance Framework (NQAF*) approved by the National Skill Qualification Committee on 21.07.2016. If the State is engaging Vocational Teachers/Trainers through the Vocational Training Provider (VTP), it should ensure that VTP should have been accredited at NQAF Level 2 or higher.

** The National Quality Assurance Framework (NQAF) provides the benchmarks or quality criteria which the different organizations involved in education and training must meet in order to be accredited by competent bodies to provide government-funded education and training/skills activities. This is applicable to all organizations offering NSQF-compliant qualifications.*

The educational qualifications required for being a Teacher/Trainer for a particular job role are clearly mentioned in the curriculum for the particular NSQF compliant job role. The State should ensure that teachers/ trainers deployed in the schools have relevant technical competencies for the NSQF qualification being delivered. Teachers/Trainers preferably should be certified by the concerned Sector Skill Council for the particular Qualification Pack/Job role which he will be teaching. Copies of relevant certificates and/or record of experience of the teacher/trainer in the industry should be kept as record.

To ensure the quality of the Teachers/Trainers, the State should ensure that a standardized procedure for selection of (Vocational) Teachers/Trainers is followed. The selection procedure should consist of the following:

(i) Written test for the technical/domain specific knowledge related to the sector;
(ii) Interview for assessing the knowledge, interests and aptitude of trainer through a panel of experts from the field and state representatives; and
(iii) Practical test/mock test in classroom/workshop/laboratory.

In case of appointment through VTPs, the selection may be done based on the above procedure by a committee having representatives of both the State Government and the VTP.

The State should ensure that the Teachers/ Trainers who are recruited should undergo induction training of 20 days for understanding the scheme, NSQF framework and Vocational Pedagogy before being deployed in the schools.

The State should ensure that the existing trainers undergo in-service training of 5 days every year to make them aware of the relevant and new techniques/approaches in their sector and understand the latest trends and policy reforms in vocational education.

The Headmaster/Principal of the school where the scheme is being implemented should facilitate and ensure that the (Vocational) Teachers/Trainers:

- Prepare session plans and deliver sessions which have a clear and relevant purpose, and which engage the students;
- Deliver education and training activities to students, based on the curriculum to achieve the learning outcomes;
- Make effective use of learning aids and ICT tools during the classroom sessions;
- Engage students in learning activities, which include a mix of different methodologies, such as project-based work, teamwork, practical and simulation-based learning experiences;
- Work with the institution's management to organise skill demonstrations, site visits, on-job trainings, and presentations for students in cooperation with industry, enterprises and other workplaces;
- Identify the weaknesses of students and assist them in up-gradation of competency;
- Cater to different learning styles and level of ability of students;
- Assess the learning needs and abilities, when working with students with different abilities
- Identify any additional support the student may need and help to make special arrangements for that support;
- Provide placement assistance

Assessment and evaluation of (Vocational) Teachers/Trainers is very critical for making them aware of their performance and for suggesting corrective actions. The States/UTs should ensure that the performance of the (Vocational) Teachers/Trainers is appraised annually. Performance based appraisal in relation to certain pre-established criteria and objectives should be done periodically to ensure the quality of the (Vocational) Teachers/Trainers.

Following parameters may be considered during the appraisal process:

- Participation in guidance and counseling activities conducted at Institutional, District and State level;
- Adoption of innovative teaching and training methods;
- Improvement in result of vocational students of Class X or Class XII;
- Continuous up-gradation of knowledge and skills related to the vocational pedagogy, communication skills and vocational subject;
- Membership of professional society at District, State, Regional, National and International level;
- Development of teaching-learning materials in the subject area;
- Efforts made in developing linkages with the Industry/Establishments;
- Efforts made towards involving the local community in Vocational Education
- Publication of papers in National and International Journals;
- Organisation of activities for promotion of vocational subjects;
- Involvement in placement of students/student support services.