

**Secondary Level School Curriculum**  
**(Technical and Vocational Stream)**  
**(Grade 9 - 12)**

**Civil Engineering**  
**2078**

**Government of Nepal**  
**Ministry of Education, Science and Technology**  
**Curriculum Development Centre**  
**Sanothimi, Bhaktapur**

**Ministry of Education  
Curriculum Development Centre  
Sanothimi, Bhaktapur**

**© Publisher**

**All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any other form or by any means for commercial purpose without the prior permission in writing of Curriculum Development Centre.**

## **Preface**

Secondary Level Education in Nepal aims to produce skillful healthy citizens familiar with national customs, culture, social heritage and democratic values who can actively take part in the economic development of the country. So, the main aim of this level is to produce skilled manpower who can make special contribution to the country's all-round development, and at the same time, to produce conscious citizens with essential knowledge and skills to be ready for university education. The process of developing and revising school level curricula in Nepal is being continued in line with this objective.

In this connection, in order to bring relevant changes in secondary level curricula as per the recommendations of School Sector Development Plan (SSDP), some subjects, i. e. Plant Science, Animal Science, Computer Engineering, Electrical Engineering and Civil Engineering have been introduced under Technical and Vocational stream. According to this provision, the curricula of these subjects have been prepared, and they are being implemented. Considering the situation that the curricula of these subjects are not easily available at present, they have been published for the wider circulation. This curriculum, revised in 2078 B. S., is one of them.

Revising school level curricula is a continuous process and the role of teachers, parents and scholars is vital in making it more effective in future. Therefore, the Curriculum Development Centre always anticipates constructive suggestions from all the persons concerned.

**2078 B.S.**

**Curriculum Development Centre  
Sanothimi, Bhaktapur**

# Content

S.N.	Subjects	Page No.
<b>Grade : 9 (Nine)</b>		
1.	Computer and Drawing	1
2.	Water Supply and Sanitary Engineering	16
3.	Construction Technology and Workshop	27
4.	Water Resource Engineering	38
<b>Grade : 10 (Ten)</b>		
1.	Building Construction and Drawing	49
2.	Highway Engineering	62
3.	Engineering Surveying- I	73
4.	Estimating, Costing and Supervision – I	86
<b>Grade 11-12</b>		
<b>A. Compulsory Subject</b>		
1.	English	97
2.	Nepali	128
3.	Social Studies	151
<b>B. Academic Subjects</b>		
1.	Mathematics	172
2.	Chemistry	189
3.	Physics	226

**C. Disciplinary Subjects**

**Grade : 11 (Eleven)**

1.	Geo-Technical Engineering	271
2.	Estimating, Costing and Supervision	285
3.	Engineering Surveying	295
4.	Applied Mechanics	306

**Grade : 12 (Twelve)**

1.	Mechanics of Structural	316
2.	Fluids Mechanics	329
3.	RCC Structure	339
4.	Construction Management	349

# Grade Nine

## Computer and Drawing

**Grades: 9**

**Credit hrs: 4**

**Working hrs: 128**

### **1. Introduction**

Computer and drawing curriculum aims to prepare skilled full and good knowledge on the computer and its application on the civil engineering and also the drawing makes the student able to design, draw different shape and geometrical construction. Computer and drawing are co related to each other that student can apply the computer technology to draw the drawing which makes work easy and fast.

This curriculum comprises of fundamental conceptual principles and practices, an introduction to computer, computer system, operating System, application of software, networks and Internet, Introduction of drawing, introduction of line and geometrical shape, scale, lettering, dimensioning, geometrical construction, draw curves, draw parabola and ellipse, orthographic, projection, draw isometric views, section, surface development, land measurement/symbol. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

On completion of the course, the students will have the following competencies:

### **2. Competencies**

1. Develop a sense of information technology culture and an appreciation of the range and power of computer applications.
2. Describe computer system and operating system of computer
3. Acquire knowledge of multimedia.
4. Create idea about the network & use of internet.

5. Practice engineering drawing and its instrument .
6. Develop skill to draw line & geometric shape.
7. Learn to technique of scale use in engineering drawing.
8. Understand the skill for letter writing in different case.
9. Acquire dimensioning technique of drawing.
10. Create idea to draw geometrical construction.
11. Develop knowledge to draw curve, parabola & ellipse.
12. Create concept about orthographic projection.
13. Develop skill about isometric view.
14. Create idea about section of drawing.
15. Understand the knowledge of surface development and land measurement.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
<b>Computer</b>		
1	Introduction to Computer	1.1 Describe mputer works.
2	Computer Components	2.1. Describe components of computer system. 2.2. Explain input device. 2.3. Explain output device. 2.4. Define memory units.
3	Operating System	3.1. Introduce operating System. 3.2. Define type-Batch, Single, Multi programming, Multi processing, Multi-tasking, Multiprocessing, Timesharing, Real time. 3.3. Explain windows Operating System Introduction to GUI and its feature Working with a Window Environment and Window Application Program. 3.4. Describe open Sources Operating System Introduction of Open Sources Operating System Introduction to Linux, UNIX.
4	Multimedia	4.1. Introduce multimedia. 4.2. Explain components of multimedia.

5	Networks and Internet	<p>5.1 Introduce computer networks.</p> <p>5.2 Describe type of network: LAN, MAN, WAN, and Internet.</p> <p>5.3 Explain use of internet.</p>
Drawing		
6	Introduction of drawing	<p>6.1 Compare types of drawing.</p> <p>6.2 Evaluate engineering drawing as universal language of engineering technical persons.</p> <p>6.3 Introduce drawing materials like drawing sheet, base paper, marking tape etc.</p> <p>6.4 Introduce drawing tools like T-square, Set- square pencil, compass scale etc.</p>
7	Introduction of line and geometrical shape	<p>7.1 Define line and its type, line weight and their uses.</p> <p>7.2 Introduce geometrical shape like rectangle, square triangle parallelogram, rhombus and polygon.</p> <p>7.3 Define circle and its parts name.</p>
8	Scale	<p>8.1 Define scale and its use.</p> <p>8.2 Define full scale.</p> <p>8.3 Define reduced scale.</p> <p>8.4 Define enlarge scale.</p> <p>8.5 Explain scale construction (Reducing and enlarging scale).</p> <p>8.6 Practice the drawing of various length line using the scale.</p>
9	Lettering	<p>9.1 Introduce single and double stroke letter.</p> <p>9.2 Define vertical and inclined letter.</p> <p>9.3 Define height and width ratio of the letter.</p> <p>9.4 Practice of letter writing of upper case and lower case letter.</p> <p>9.5 Practice of Devanagari letter.</p>

10	Dimensioning	<p>10.1 Explain dimension system.</p> <p>10.2 Define chain and size dimension.</p> <p>10.3 Practice dimension and extension line placement of dimension text.</p> <p>10.4 Use of arrow head, dot and slash in dimension.</p>
11	Geometrical Construction.	<p>11.1. Define geometrical shape and their name.</p> <p>11.2. Practice construction of 90-, 60-degree angle and given angles.</p> <p>11.3. Practice construction of triangles by given side.</p> <p>11.4. Practice construction of rectangle, square, pentagon hexagon, Heptagon etc</p> <p>Division</p> <p>11.5 Practice bisection and trisection of line and angle.</p> <p>11.6 Practice line dividing in any number of equal parts.</p> <p>11.7 Practice circle- dividing five, six,, seven and eight equal parts.</p> <p>Tangent</p> <p>11.8 Practice line tangent to a circle from any point.</p> <p>11.9 Practice uncrossed (open belt) and crossed (crossed belt) line tangent.</p> <p>11.10 Practice arc tangent (Internal, external and combined).</p>
12	Draw Curves	<p>12.1 Introduce curve and its type.</p> <p>12.2 Define line and circular involutes.</p> <p>12.3 Define cycloid.</p> <p>12.4 Define helices (cylindrical and conical helix).</p>
13	Draw Parabola and Ellipse	<p>13.1 Introduce cone and its terminology and various shapes, when it will be occurs.</p> <p>13.2 Practice ellipse (concentric circle, oblong, and foci method).</p> <p>13.3 Practice parabola (rectangle, tangent method).</p>

14	Orthographic Projection	<p>14.1 Define theory of projection.</p> <p>14.2 Introduce principal plane.</p> <p>14.3 Introduce first and third angle projection.</p> <p>14.4 Compare difference between first and third angle projection.</p> <p>14.5 Practice projection of point(s) and line(s) in first angle projection.</p> <p>14.6 Practice projection of line: Parallel to HP, parallel to VP and perpendicular to HP and VP. Inclined to HP and VP.</p> <p>14.7 Practice orthographic projection of prism, cylinder, pyramid and cone.</p> <p>14.8 Practice orthographic projection of different models with flat, inclined and circular surface.</p>
15	Draw isometric views	<p>15.1 define isometric projection.</p> <p>15.2 Describe isometric scale.</p> <p>15.3 Practice process of preparation of isometric drawing.</p> <p>15.4 Practice free hand sketch of isometric view.</p>
16	Section	<p>16.1 Explain need and importance of section.</p> <p>16.2 Compare different type of sectional plane.</p> <p>16.3 Practice types of section (Longitudinal and crossed section, as well as full and half section).</p> <p>16.4 Practice sectional view of simple object.</p>
17	Surface Development.	<p>17.1 Introduce surface Development.</p> <p>17.2 Practice method of surface development (parallel and radial line method).</p>
18	Land measurement /Symbol	<p>18.1 Practice land measurement by triangulation method.</p> <p>18.2 Practice unit of length/Unit of land Roppani/Bigha/Hectare.</p> <p>18.3 Practice general symbol of civil, domestic electrical (fixtures) works and plumbing works.</p>

#### 4. Scope and Sequence of Contents

##### Part: 1 Computer

Unit	Scope	Content	Hrs.
1.	Introduction to Computer	1.1 The concepts and history of computer 1.2 The computer system characteristics 1.3 The Capabilities and limitation of computer 1.4 Generation and types of computer 1.5 Computer works	3
2.	Computer components	2.1 Basic components of computer system 2.2 Input unit 2.3 Output unit 2.4 Memory units 2.5 Processing unit 2.6 Input device ; keyboard, mouse, joystick, OMR, OCR, BCR, MICR, Scanner, Touch screen, Touch pad, micro phone, digital camera 2.7 Output device; monitor, speaker, printer, projector, headphone 2.8 Memory units; primary & secondary	7
3	Operating System	3.1 Introduction of operating System 3.2 Type-Batch, Single, Multi programming, Multi processing, Multi tasking, Multi processing, Timesharing, Real time 3.3 Windows Operating System Introduction to GUI and its feature Working with a Window Environment and Window Application Program 3.5 Open Sources Operating System Introduction of Open Sources Operating System Introduction to Linux, UNIX	6

4	Multimedia	4.1 Introduction to multimedia 4.2 Components of multimedia <ul style="list-style-type: none"> <li>● Text</li> <li>● Audio</li> <li>● Video</li> <li>● Animation</li> </ul> 4.3. Application of multimedia	6
5	Networks and Internet	5.1 Introduction of computer networks 5.2 Type of network: LAN, MAN, WAN, and Internet (Introduction Only) 5.3. Use of internet. <ul style="list-style-type: none"> <li>● Email</li> <li>● Search engine</li> <li>● E-commerce</li> <li>● E- governance</li> <li>● E-banking</li> </ul>	6
		<b>Sub-Total</b>	28

## Part: 2 Drawing

Unit	Scope	Content	Hrs.
6	Introduction of drawing	6.1 Types of drawing 6.2 Engineering drawing as universal language of engineering technical persons. 6.3 Introduction of drawing materials like drawing sheet, base paper, marking tape etc. 6.4 Introduction of drawing tools like T-square, Set-square pencil, compass scale etc.	1
7	Introduction of line and geometrical shape	7.1 Definition of line and its type, line weight and their uses. 7.2 Introduction of geometrical shape like rectangle, square triangle parallelogram, rhombus and polygon. 7.3 Circle and its parts name.	2

8	Scale	8.1 Knowledge of scale and its use 8.2 Full scale	1
		8.3 Reduced scale 8.4 Enlarge scale 8.5 Scale construction (Reducing and enlarging scale) 8.6 Practicing the drawing of various length line using the scale	
9	Lettering	9.1 Introduction of single and double stroke letter 9.2 Vertical and inclined letter. 9.3 Height and width ratio of the letter. 9.4 Practice of letter writing of upper case and lower case letter. 4.5 Practice of Devanagari letter.	3
10	Dimensioning	10.1 Dimension system 10.2 Chain and size dimension 10.3 Dimension and extension line placement of dimension text. 10.4 Uses of arrow head, dot and slash in dimension	2
11	Geometrical Construction.	11.1. Know about the geometrical shape and their name 11.2. Construction of 90-, 60-degree angle and given angles 11.3. Construction of triangles by given side 11.4. Construction of rectangle, square, pentagon hexagon, Heptagon etc Division 11.5 Bisection and trisection of line and angle 11.6 Line dividing in any number of equal parts 1.7 Circle- dividing five, six,, seven and eight equal parts Tangent 11.8 Line tangent to a circle from any point 11.9 Uncrossed (open belt) and crossed (crossed belt) line tangent 11.10 Arc tangent (Internal, external and combined)	6

12	Draw Curves	12.1 Introduction of curve and its type 12.2 Line and circular involutes 12.3 Cycloid 12.4 Helices (cylindrical and conical helix)	3
13	Draw Parabola and Ellipse	13.1 Introduction of cone and its terminology and various shapes, when it will be occurs 13.2 Ellipse (concentric circle, oblong, and foci method) 13.3 Parabola (rectangle, tangent method)	4
14	Orthographic Projection	14.1 Theory of projection 14.2 Introduction principal plane 14.3 Introduction of first and third angle projection 14.4 Difference between first and third angle projection. 14.5 Projection of point(s) and line(s) in first angle projection 14.6 Projection of line: Parallel to HP, parallel to VP and perpendicular to HP and VP. Inclined to HP and VP 14.7 Orthographic projection of prism, cylinder, pyramid and cone 14.8 Orthographic projection of different models with flat, inclined and circular surface	6
15	Draw isometric views	15.1 Isometric projection 15.2 Isometric scale 15.3 Process of preparation of isometric drawing 15.4 Free hand sketch of isometric view	3
16	Section	16.1 Need and importance of section 16.2 Different type of sectional plane 16.3 Types of section (Longitudinal and crossed section, as well as full and half section) 16.4 Practicing of sectional view of simple object	2
17	Surface Development.	17.1 Introduction of surface Development 17.2 Method of surface development (parallel and radial line method)	2

18	Land measurement /Symbol	18.1 Land measurement by triangulation method 18.2 Unit of length/Unit of land Ropani/Bigha/Hectare 18.3 General symbol of civil, domestic electrical (fixtures) works and plumbing works	1
		<b>Total</b>	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 9		
	Scope	Practical Activities	Hrs.
<b>Computer</b>			
2	Computer Components	2.1 Introduce with computer hardware like motherboard, CPU, Input and output devices	6
3	Operating System	3.1 Install Operating software like Windows XP. 3.2 Install various application software like MS office and Utility software like antivirus.	6
4	Multimedia	4.1 Draw Flow charts and introduce with Q basic 4.2 Work with Microsoft office package especially WORD, EXCEL and POWERPOINT. Familiarize students with different tools associated with each application. 4.3 Prepare Bio Data by using MS word 4.4 Make library management system using MS Excess 4.5 Prepare power point slides about their school 4.6 Prepare the Mark sheet in MS Excel 4.7 Make the graphical representation ( graph, pie chart and so on) in MS EXCEL	6
		4.8 Make tables and tabulate data in MS EXCEL	

5	Networks and Internet	5.1 Practice on network system using LAN, MAN, WAN 5.2 Practice email, search engine	6
<b>Drawing</b>			
6	Introduction of drawing	6.1 Introduction to tools, paper and drawing.	1
7	Introduction of line and geometrical shape	7.1 Introduction to geometric shape: construction of polygonal shape, bisect and intersection, tangent, curve (cycloid, involute) and conic sections.	1
8	Scale	8.1 Practice using scale (reducing and enlarging).	2
9	Lettering	9.1 Draw on practice lettering writing.	2
10	Dimensioning	10.1 Practice on dimensioning	1
11	Geometrical Construction.	11.1 Construct geometric shape, tangent, divide.	3
12	Draw Curves	12.1 Construct geometric shape, tangent, divide.	3
13	Draw Parabola and Ellipse	13.1 Draw the ellipse, parabola, and hyperbola.	4
14	Orthographic Projection	14.1 Practice on orthographic projection.	7
15	Draw isometric views	15.1 Practice on isometric view.	8
16	Section	16.1 Practice on section: full section and half section.	3
17	Surface Development	17.1 Practice on method of surface development.	3
18	Land measurement / Symbol	18.1 Practice on land measurement by triangulation methods.	2
	Total		64

## 6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Group Discussion
- Demonstration

- Case study
- Questionnaire
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.
- Assignment and presentation

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weight age. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, class-work, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2

4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weight age. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Subject: Computer and Drawing

Time: 2 Hrs. Full Marks: 50

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction To Computer and	3	6	1	0	2	2	1	1	2	1	9	5	2	16	9	25	16	2
2	Computer System	7																	5
3	Operating System	6																	5
4	Multimedia	6																	5
5	Networks and Internet	6																	5
6	Introductionof drawing	1																	1
7	Introduction of line and geometrical shape	2																	1
8	Scale	1																	1
9	Lettering	3																	2
10	Dimensioning	2																	1
11	Geometrical Construction.	6																	6

12	Draw Curves	3																	2
13	Draw Parabola and Ellipse	4																	4
14	Orthographic Projection	6																	5
15	Draw isometric views	3																	2
16	Section	2																	1
17	Surface Development.	2																	1
18	Land measurement/Symbol	1																	1
	Total	64	6	1	0	2	2	1	1	2	1	9	5	2	16	9	25	16	50

# Water Supply and Sanitary Engineering

**Grades: 9**

**Credit hrs: 4**

**Working hrs: 128**

## **1. Introduction**

Water supply and sanitary course is designed to describe basic knowledge and give information about the water, its supply system and treatment. Its intends to provide knowledge of source of water, selection, demand and quality of water. Sanitary explain the sanitation system and its management.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, sources of water, demand of water, quality of water, treatment of water, distribution of water, plumbing, introduction of sanitation, sewage disposal, disposal of excreta in un-sewered area and solid waste management. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

- 1 Develop a sense of water and needs of water for human body.
- 2 Acquire knowledge about source of water supply.
- 3 Uses of water supply.
- 4 Acquire knowledge about quality, quantity & treatment of water.
- 5 Create idea to develop water supply project.
- 6 Create idea about sanitary system.
- 7 Develop knowledge of solid & liquid waste management.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1.	Introduction	1.1 Explain importance water to life and our environment. 1.2 Explain importance of water and sanitation. 1.3 Describe objectives of water supply system. 1.4 Community mobilization for construction and maintenance of water supply.
2.	Sources of water	2.1 Define source of water. 2.2 Explain surface water(stream, river, lake). 2.3 Explain ground water (well, spring). 2.4 Explain source selection criteria. 2.5 Practice discharge measurement (volumetric method). 2.6 Explain source protection plan.
3	Demand of water	3.1 Explain types of water demand. 3.2 Describe demand. 3.3 Explain factors affecting water demand. 3.4 Explain population forecast. 3.5 Practice demand calculation.
4	Quality of water	4.1 Characterize of safe water. 4.2 Define water pollutants and their effects on health. 4.3 Compare diseases related to water; their causes and prevention. 4.4 Explain water-borne diseases. 4.5 Explain water based diseases. 4.6 Explain water vector transmitted diseases. 4.7 Explain water - washed. 4.8 Identify transmission routes. 4.9 Describe preventive measures. 4.10 Drinking water quality standards ( WHO, GoN). 4.11 Water sampling and storing.

		4.12 Physical analysis (temperature, color, turbidity, taste and odour) 4.13 Chemical analysis (total solids, pH, chlorine).
5	Treatment of water	5.1 Explain need of water treatment. 5.2 Define screening. 5.3 Explain Sedimentation. 5.4 Define Filtration. 5.5 Define aeration. 5.6 Explain Disinfection. 5.7 Define Water softening.
6	Distribution of water	6.1 Compare requirements of good distribution system. 6.2 Explain methods of supply. 6.3 Explain clear water reservoir. 6.4 Define break pressure tank. 6.5 Explain types of pipes. 6.6 Explain laying of pipes. 6.7 Compare types of joints. 6.8 Define valves & fittings. 6.9 Explain maintenance of pipes.
7	Introduction of sanitation	7.1 Define sanitation and role of sanitation in maintenance of health. 7.2 Explain System of sanitation. 7.3 Define valves and fittings. 7.4 Describe System of sewerage. 7.5 Explain Type of sewers. 7.6 Explain Laying of sewers.
8	Sewage Disposal	8.1 Describe importance of disposal of sewerage. 8.2 Define land treatment. 8.3 Define dilution method.

		8.4 Explain self-purification of river. 8.5 Explain Laying of sewers.
9	Disposal of excreta in un-sewered area	9.1 Define pit privy. 9.2 Explain VIP latrine. 9.3 Draw pour flush latrine. 9.4 Define septic tank.
10	Solid Waste Management	10.1 Define solid waste. 10.2 Explain types of waste; their dangers and disposal. 10.3 Define onsite management. 10.4 Explain waste segregation. 10.5 Describe collection of solid waste. 10.6 Explain 4R principle. 10.7 Define composting.

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Introduction	1.1 Importance of water to life and our environment 1.2 Importance of water and sanitation 1.3 Objectives of water supply system 1.4 Community mobilization for construction and maintenance of water supply	5
2.	Sources of water	2.1 Define sources of water 2.2 Surface water(stream, river, lake) 2.3 Ground water (well, spring) 2.4 Source selection criteria 2.5 Discharge measurement (volumetric method) 2.6 Source protection plan 2.7 Numerical practice	6

3	Demand of water	3.1 Types of water demand 3.2 Demand. 3.3 Factors affecting water demand 3.4 Population forecast 3.5 Demand calculation	7
4	Quality of water	4.1 Characteristics of safe water 4.2 Water pollutants and their effects on health. 4.3 Diseases related to water; their causes and prevention. 4.4 Water-borne diseases 4.5 Water based diseases 4.6 Water vector transmitted diseases 4.7 Water - washed 4.8 Transmission routes 4.9 Preventive measures 4.10 Drinking water quality standards ( WHO, GoN) 4.11 Water sampling and storing 4.12 Physical analysis (temperature, color, turbidity, taste and odour) 4.13 Chemical analysis (total solids, pH, chlorine)	8
5	Treatment of water	5.1 Need of water treatment 5.2 Screening 5.3 Sedimentation 5.4 Filtration 5.5 Aeration 5.6 Disinfection 5.7 Water softening	7
6	Distribution & Plumbing system	6.1 Requirements of good distribution system 6.2 Methods of supply 6.3 Clear water reservoir	

		6.4 Break pressure tank 6.5 Types of pipes 6.6 Laying of pipes 6.7 Pipe joints 6.8 Valve & fittings 6.9 Maintenance of pipes	8
7	Introduction of sanitation	7.1 Definition and role of sanitation in maintaining of health 7.2 Systems of sanitation 7.3 System of sewerage 7.4 Types of sewers 7.5 Laying of sewers	5
8	Sewage Disposal	8.1 Importance of disposal of sewage 8.2 Land treatment 8.3 Dilution method 8.4 Self-purification of river	6
9	Disposal of excreta in un-sewered area	9.1 Pit privy 9.2 VIP latrine 9.3 Pour flush latrine 9.4 Septic tank	6
10	Solid Waste Management	10.1 Definition 10.2 Types of wastes; effects and disposal 10.3 Onsite management 10.4 Waste segregation 10.5 Collection of solid waste 10.6 4R principle	6
		Total	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and

fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 9		
	Scope	Practical Activities	Hrs.
1.	Introduction	1.1 Prepare plan to organize WSSUG for community mobilization for construction and maintenance of water supply in any village or tole	2
2.	Sources of water	2.1 Perform Measurement of the discharge at the source of water supply in your school or nearby source and calculate safe yield and design yield 2.2 Prepare Source protection plan for a spring/ stream or well source.	8
3	Demand of water	3.1 Forecast the population for any ward of your village by arithmetic increase method 3.2 Calculate the demand of water for above population	6
4	Quality of water	4.1 Survey the water related diseases in your community with their possible route of transmission and recommend prevention plan for them. 4.2 Determine physical parameters (Color, Turbidity, Temperature) <sup>3</sup> 4.3 Determine pH value	7
5	Treatment of water	5.1 Demonstrate Particle settling in quiescent sedimentation tank 5.2 Demonstrate Water filtration in a sand filter developed in small scale	5
6	Distribution of Water & Plumbing	6.1 Design of water reservoir with inlet and outlet system 6.2 Design a break pressure tank 6.3 Identify different type of pipes and fittings 6.4 Prepare different pipe joints 6.5 Perform different pipe joining and fittings	9
7	Introduction of sanitation	7.1 Prepare sewer laying plan	5

8	Sewage Disposal	8.1 Observe land treatment of sewage in artificially prepared bed	4
9	Disposal of excreta in un-sewered area	9.1 Design and draw free hand sketches of Pit privy, VIP latrine, Pour flush latrine	6
10	Solid Waste Management	10.1 Perform segregation of waste from school including canteen 10.2 Perform composting of organic waste in compost bin or compost pit	12
	Total		64

## 6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In particular, the teacher can make use of the following methods and strategies for the learning facilitation:

- Group Discussion
- Case study
- Questionnaire
- Demonstration
- Field Visit and report presentation
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving
- Assignment and Presentation.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of

evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

**(a) Internal Evaluation**

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their

own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 9

Subjects : Water Supply and Sanitary Engineering

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	5	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	4
2	Sources of water	6																	5
3	Demand of water	7																	5
4	Quality of water	8																	6
5	Treatment of water	7																	5
6	Distribution of Water & plumbing	8																	6
7	Introduction of sanitation	5																	4
8	Sewage Disposal	6																	5
9	Disposal of excreta in un-sewered area	6																	5
10	Solid Waste Management	6																	5
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

# Construction Technology and Workshop Practice

**Grades: 9**

**Credit hrs: 4**

**Working hrs: 128**

## **1. Introduction**

The construction technology and workshop course aims is to develop the knowledge on the characteristics of the different material and create the skill on the masonry work, motor preparation, different construction technique. Workshop practice directly related to the familiarization of carpentry work and electric work and its tools and application.

This curriculum comprises of fundamental conceptual principles and practices, construction materials, masonry works, concrete works, finishing works, carpenter, trees, timber, seasoning of timber, defects of wood/timber, decay of timber, preservation of wood, hard and soft wood identification, construction joints (drawing to scale), tools/equipment. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

1. Develop the knowledge about the material used in construction, its properties and important.
2. Create the technique to mason the different stone masonry and brick masonry.
3. Accumulate the skill and technology of concrete work, controlling proportion reinforcement of concrete work.
4. Learn the techniques finishing works.
5. Understand the principles of carpentry works and profession
6. Select and collect the hand tools required for conduction of carpentry works;

7. Give the concept on conversion techniques.
8. Knowledge of timber defect and method of preservation.
9. Perform shaving and joints making.
10. Develop skill of house wiring.

### 3. Learning Outcomes

Unit	Content Area	Learning Outcomes
Construction Technology		
1.	Construction materials	1.1 Define construction material. 1.2 Familiarize with different building materials and their uses. 1.3 Explain the types, properties and uses of mortars.
2.	Masonry Works	2.1 Describe various types of masonry works and their uses. 2.2 Classify stone masonry works, Define Bond and Bond stone. Describe defects in stone and stone masonry. 2.3 Explain types of brick masonry and types of bond used, mortar used, construction techniques and defects in brick masonry; define terminologies used in brick masonry. 2.4 Define Block work and enlist its uses.
3.	Concrete Works	3.1 Define concrete works. 3.2 Enlist the materials used in concrete works, properties and uses. Describe preparation of concrete. 3.3 Discuss types of formworks. Types (Timber, Plywood and steel), List the importance and characteristics and requirements of good formwork. Rewrite stripping of formwork. 3.4 Define reinforcements. List its importance. Describe its placement and concreting. 3.5 Define Compaction and curing of concrete. 3.6 List factors affecting strength of concrete.
4.	Finishing Works	4.1 Define Finishing works. Name the types of building finishes and enlist importance.

		4.2 Describe Various floor finishes. 4.3 Explain Various wall finishes and their types. 4.4 Describe Various ceiling finishes. 4.5 Explain Various roof finishes.
<u>Workshop Technology</u>		
5.	Carpentry	5.1 Explain importance and scope of carpentry. 5.2 Name different woodworking professions. 5.3 Enlist various types of hand/power driven tools/equipment required to carpenter. 5.4 Recall Care and maintenance of tools and equipment. 5.5 Discuss safety and precautions in wood workshop.
6.	Trees	6.1 Define wood. Draw cross-section of tree with name of different parts. 6.2 State characteristics of common Nepalese wood. 6.3 Describe growth of tree. 6.4 Explain Grain of wood section and strength of wood. 6.5 Discuss methods and tools for felling trees. 6.6 Name characteristics and example of hard wood and soft wood.
7.	Timber	7.1 Define timber. 7.2 State application, advantage and disadvantage of timber. 7.3 Explain purpose and methods of timber conversion. 7.5 Define seasoning of timber and its objectives. 7.6 Discuss various methods of seasoning .
8.	Defects of Timber and methods of preservation	8.1 Redefine defects of timber. 8.2 Explain the types of timber defects. 8.3 Identify shrinkage of wood. 8.4 Define wood preservation and state its purpose. 8.5 Describe oil soluble and water soluble preservatives. 8.6 Describe hot and cold bath method. 8.7 Explain pressure method of preservation.

		8.8 Explain preservative for termite protection.
		8.9 Discuss different types of paints and their application.
9.	Construction joints drawing to scale)	9.1 Define construction joints and recall its purpose. 9.2 Name types of joints and State their use: 9.3 Sketch Cross half lap joint. 9.4 Sketch Mortise and Tenon joint. 9.5 Draw Dovetail cross half lap joint. 9.6 Draw Dovetail bridle joint. 9.7 Sketch Dado joint. 9.8 Sketch Mitered joint. 9.9 Sketch Butt joint.
10.	Introduction to electricity and house wiring system	10.1 Define electricity and name sources of electricity. 10.2 Enlist different electric equipment. 10.3 Draw different electric symbols. 10.4 Explain house wiring process.

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
Construction Technology			
1.	Construction materials	1.1 Introduction to construction material 1.2 Building materials: Building stones, Bricks, Blocks, Timber, Glass, plastics, bitumen, Cement Stabilized Earthen Block (CSEB), their properties and uses in construction, Other materials: Autoclaved Aerated Concrete (AAC) blocks, Polymer blocks 1.3 Mortars: Types, properties and uses	8
2.	Masonry Works	2.1 Introduction to Masonry works of various types and their uses 2.2 Stone masonry: Bonds, Bond Stone, And Classification of stone masonry: Rubble masonry, Ashlar Masonry, Defects in stone and stone masonry.	8

		2.3 Brick masonry: Types: Stretcher, Header, English, Flemish Bonds, terminologies, mortar used and construction techniques 2.4 Defects in Brick Masonry 2.5 Block work and its uses	
3.	Concrete Works	3.1 Introduction to concrete works 3.2 Materials used in concrete works, preparation, properties and uses 3.3 Formworks: types (Steel, Timber and Plywood), importance, characteristics and requirements of Formwork 3.4 Reinforcements, importance, placement and concreting 3.5 Compaction and curing of concrete 3.6 Factor affecting strength of concrete	10
4.	Finishing Works	4.1 Definition, types of building finishes, importance 4.2 Various floor finishes 4.3 Various wall finishes and their types 4.4 Various ceiling finishes 4.5 Various roof finishes	5
<b>Workshop Technology</b>			
5.	Carpentry	5.1 Importance and Scope of carpenter 5.2 Different woodworking professions (Furniture maker/Wood carver/Construction carpenter) 5.3 Various types of hand/power driven tools/equipment required to carpenter 5.4 Care and maintenance of tools and equipment. 5.5 Safety and precautions in wood workshop	4
6.	Trees	6.1 Wood, cross-section of tree with name of different parts 6.2 Characteristics of common Nepalese wood	5

		6.3 Growth of tree 6.4 Grain of wood section and strength of wood 6.5 Methods and tools for felling trees 6.6 Characteristics and example of hard wood and soft wood	
7.	Timber	7.1 Definition of timber 7.2 Application, Advantage and Disadvantage 7.3 Timber conversion, purpose and Methods (Through and through sawn/Tangential sawn/Rift or quarter sawn) 7.4 Seasoning of timber (Definition and objectives) 7.5 Various methods of seasoning (Natural and Artificial Seasoning) 7.6 Moisture content of timber and moisture meter	6
8.	Defects of Timber and methods of preservation	8.1 Definition 8.2 Defects due to natural forces/fungi/insects/during seasoning and conversion) 8.3 Shrinkage of wood 8.4 Definition and Purpose of wood preservation 8.5 Oil soluble and water soluble preservatives 8.6 Hot and cold bath method 8.7 Pressure method of preservation 8.8 Preservation from termite in a building 8.9 Different types of paints and their application	10
9.	Construction joints (drawing to scale)	9.1 Definition and purpose 9.2 Types of joints and their use: 9.3 Cross half lap joint 9.4 Mortise and Tenon joint 9.5 Dovetail cross half lap joint 9.6 Dovetail bridle joint	4

		9.7 Dado joint 9.8 Mitered joint 9.9 Butt joint	
10.	Introduction to electricity and House wiring System	10.1 Electricity and sources of electricity 10.2 Different electric symbols 10.3 House wiring process	4
Total			64

### 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

#### Construction Technology

Unit	Scope	Activities	Hrs.
1	Construction Materials	1.1 Demo of different material : Brick, Sand, Cement, Stone etc.  *Arrange the field trip on the brick factory*	5
2	Masonry Works	2.1 Practice on different bond: Header bond, stretcher bond, Flemish bond, English bond etc.	6
3	Concrete Works	3.1 Practice on PCC and different concrete work  *Arrange the field trip on the cement factory, and different area of civil concrete work*	8
4	Finishing Works	3.4 Demo of finished material and different practice: plastering and painting on wall	4

#### Workshop Practice

Unit	Scope	Activities	Hrs.
5	Carpentry	5.1 Demonstration of tools & equipment of carpentry	5
6	Tree	6.1 Draw cross section of tree, tools for feeling tree	5
7	Timber	7.1 Draw different types of seasoning of timber	5

8	Defects of timber & methods of preservation	8.1	Demonstration of different types of defects	6
9	Construction Joint	9.1	Introduction to sharpening technique	10
		9.2	Practice in assembling & disassembling of plane	
		9.3	Producing a smooth by planing to timber	
		9.4	Practice in cutting	
		9.5	Practice on chiseling to make mortise & tenon	
		9.6	Make a joint of mortise & tenon	
10	Introduction to electricity & house wiring system	10.1	Practice on domestic wiring system on plane board	10
		10.2	Practice on connection of switch & bulbs, sockets	
		Total		64

## 6. Learning Facilitation Method and Process

Learning facilitation process is the crux of the teaching and learning activity. One topic can be facilitated through two or more than two methods or processes. The degree of usage will be based on the nature of the content to be facilitated. However, a teacher should focus on methods and techniques that are more students centered and appropriate to facilitate the content. The following facilitation methods, techniques and strategies will be applied while conducting the teaching learning process:

- Group Discussion and Individual work.
- Field Visit and report presentation
- Demonstration
- Questionnaire
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of

evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, class-work, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

#### Note:

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every

member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

### Specification Grid

**Grade: 9**

**Subjects : Construction Technology and Workshop Practice**

**Time : 2 hrs.**

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Construction materials	8	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	6
2	Masonry Works	8																	6
3	Concrete Works	10																	8
4	Finishing Works	5																	4
5	Carpenter	4																	3
6	Trees	5																	4
7	Timber	6																	5
8	Defects of Timber and methods of preservation	10																	8
9	Construction joints (drawing to scale)	4																	3
10	Introduction to electricity and House wiring System	4																	3
	<b>Total</b>	<b>64</b>	<b>7</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>16</b>	<b>9</b>	<b>25</b>	<b>16</b>	<b>50</b>

# Water Resources Engineering

**Grades: 9**

**Credit hrs: 4**

**Working hrs: 128**

## **1. Introduction**

Water Resources engineering course provide knowledge of the irrigation system and management. Its will design the crop production technique and its management. Its deals with the canal design, hydrology and flood. And the course is also give the basic knowledge of hydropower system.

This curriculum comprises of fundamental conceptual principles and practices, an introduction of irrigation, water requirement, method of irrigation, various irrigation structures, canal, water logging and drainage, hydrology and flood estimation and waterpower engineering. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

1. Develop a sense of irrigation system, types and uses.
- 2, Explain awareness about effects of irrigation.
3. Create idea to develop irrigation system.
4. Knowledge of irrigation structure
5. Acquire skills to design a canal.
6. Create idea about the hydrology.
7. Develop a sense of hydropower plant.

### 3. Grade wise learning Outcomes

Unit	Content Area	Learning outcomes
1	Introduction of irrigation	1.1 Define irrigation 1.2 Explain Necessity of irrigation 1.3 Compare Advantages and Disadvantages of irrigation 1.4 Explain Sources of water for irrigation 1.5 Define Gross command area(GCA) 1.6 Define Cultivable command area(CCA) 1.7 Define Net command area(NCA)
2	Water requirement	2.1 Define Crop season 2.2 Explain Crop types 2.3 Define Base Hrs. 2.4 Define Kor Hrs. and Kor depth 2.5 Define Crop Hrs. 2.6 Define Delta and Duty 2.7 Compute Duty delta relationship 2.8 Explain Factors affecting duty 2.9 Explain Water requirement of different crops
3	Method of irrigation	3.1 Explain Surface irrigation 3.2 Uncontrolled flooding 3.3 Check flooding 3.4 Furrow irrigation 3.5 Zig zag method 3.6 Contour Farming 3.7 Basin Flooding 3.8 Contour laterals 3.9 Define Sub surface irrigation 3.10 Define Drip irrigation 3.11 Define Sprinkler irrigation

4	Various irrigation structures	4.1 Explain Head works: Definition, and types 4.2 Canal head regulator 4.3 Cross Regulator 4.4 Cannel fall 4.5 weir and barrage 4.6 Under sluice and silt excluder. 4.7 Explain Cross-Drainage works 4.8 Aqueducts 4.9 Siphon aqueducts 4.10 Super passage 4.11 Siphon 4.12 Level crossing 4.13 Inlet and outlet  *prepare for the field trip to observe the various irrigation structures*
5	Canal	5.1 Compare Classification of canal and their alignment 5.2 Explain Canal losses, canal lining 5.3 River training works-definition, Types, objectives
6	Water logging and drainage	6.1 Define water logging 6.2 Explain Causes and effects of water logging 6.3 Describe Remedial measures 6.4 Explain Causes of canal damages, maintenance tasks 6.5 Hill irrigation practice in Nepal
7	Hydrology and flood estimation	7.1 Define hydrology 7.2 Explain hydrologic cycle 7.3 Describe measurement of Rainfall by Rain Gauges 7.4 Explain rainfall runoff process 7.5 Define infiltration 7.6 Define Evaporation and transpiration 7.7 Describe Factors affecting runoff

		<p>7.8 Describe Estimation of flood by rational method</p> <p>7.9 Explain Estimation of peak flood by Empirical methods</p> <p>7.10 Compute Stream/River discharge determination (float method, velocity rod method, current meter, velocity area method)</p> <p>7.11 Define Ground water hydrology</p> <p>7.12 Explain Types of aquifers</p> <p>7.13 Compute Ground water movement-Darcy's Law</p>
8	Waterpower engineering (Hydropower)	<p>8.1 Introduce water power engineering</p> <p>8.2 Describe hydropower development in Nepal</p> <p>8.3 Draw flow duration curve</p> <p>8.4 Define Firm (or primary) power and secondary (or Surplus) power</p> <p>8.5 Define Power system and load</p> <p>8.6 Define Load factor, utilization factor and capacity factor</p> <p>8.7 Draw General layout plan of hydropower project</p> <p>8.8 Define Run of River (ROR) and Picking type of hydropower plant (PROR)</p> <p>8.9 Introduce hydraulic turbine and types of hydraulic turbine.</p> <p>*prepare for the field trip to observe the hydropower project*</p>

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Introduction of irrigation	<p>1.1 Definition of irrigation</p> <p>1.2 Necessity of irrigation</p> <p>1.3 Advantages and Disadvantages of irrigation</p> <p>1.4 Sources of water for irrigation</p> <p>1.5 Gross command area(GCA)</p> <p>1.6 Cultivable command area(CCA)</p>	5

		1.7 Net command area(NCA)	
2.	Water requirement	2.1 Crop season 2.2 Crop types 2.3 Base Hrs. 2.4 Kor Hrs. and Kor depth 2.5 Crop Hrs. 2.6 Delta and Duty 2.7 Duty delta relationship 2.8 Factors affecting duty 2.9 Water requirement of different crops	7
3	Method of irrigation	3.1 Surface irrigation 3.2 Uncontrolled flooding 3.3 Check flooding 3.4 Furrow irrigation 3.5 Zig zag method 3.6 Contour Farming 3.7 Basin Flooding 3.8 Contour laterals 3.9 Sub surface irrigation 3.10 Drip irrigation 3.11 Sprinkler irrigation	8
4	Various irrigation structures	4.1 Head works: Definition, and types 4.2 Canal head regulator. 4.3 Cross Regulator. 4.4 Cannel fall. 4.5 weir and barrage, notch. 4.6 Under sluice and silt excluder. 4.7 Cross-Drainage works 4.8 Aqueducts.	10

		4.9 Siphon aqueducts 4.10 Super passage 4.11 Siphon 4.12 Level crossing 4.13 Inlet and outlet *prepare for the field trip to observe the various irrigation structures*	
5	Canal	5.1 Classification of canal and their alignment 5.2 Canal losses, canal lining 5.3 River training works.	6
6	Water logging and drainage	6.1 Definition of water logging 6.2 Causes and effects of water logging 6.3 Causes of canal damages, maintenance tasks. 6.4 Remedial measures 6.5 Hill irrigation practice in Nepal	8
7	Hydrology and flood stimation	7.1 Definition of hydrology 7.2 The hydrologic cycle 7.3 Measurement of Rainfall by Rain Gauges 7.4 Rainfall runoff process 7.5 Infiltration 7.6 Evaporation and transpiration 7.7 Factors affecting runoff 7.8 Estimation of flood by rational method 7.9 Estimation of peak flood by Empirical methods 7.10 Stream/River discharge determination (float method, velocity rod method, current meter, velocity area method) 7.11 Ground water hydrology 7.12 Aquifers and its types 7.13 Ground water movement-Darcy's Law	10

8	Waterpower engineering	8.1	Introduction	10
		8.2	Hydropower development in Nepal	
		8.3	Flow duration curve	
		8.4	Firm (or primary) power and secondary (or Surplus) power& total power	
		8.5	Power system and load	
		8.6	Load factor, utilization factor and capacity factor	
		8.7	General layout plan of hydropower project	
		8.8	Run of River (ROR) and Picking type of hydropower plant (PROR), storage plant.	
		8.9	Introduction and types of hydraulic turbine. *prepare for the field trip to observe the hydropower project*	
		Total		64

### 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Scope	Content Area	Hrs.	
1	Introduction of irrigation	1.1	Identify surface and ground of sources of water	11
		1.2	Identify Gross command area from a map(GCA)	
		1.3	Identify Cultivable command area from a map(CCA)	
		1.4	Identify Net command area from a map( NCA)	
2	water requirement	2.1	Perform field identification of Kor Hrs. and kor depth for different crops	9
		2.2	Perform field identification of Delta and Duty for different types of crops	

3	Method of irrigation	3.1 observe land preparation for Check flooding 3.2 observe land preparation for Ferrow irrigation 3.3 observe land preparation for Zig zag method 3.4 observe land preparation for Contour farming 3.5 observe land preparation Basin flooding 3.6 observe land preparation for Drip irrigation 3.7 Observe sprinkler irrigation system	10
4	Various irrigation structures	4.1 Prepare general layout drawing of Head works 4.2 Prepare cross sectional drawing of Canal head regulator 4.3 Prepare sectional drawing of Cannel falls 4.4 Prepare Sectional drawing of under Sluice and silt excluder. 4.5 Draw typical section of Aqueducts 4.6 Draw typical section of Siphon aqueducts 4.7 Draw typical section of Super passage 4.8 Observe hydraulics structure	15
5	Canal design concept	5.1 Draw typical cross sectional drawing of canal 5.2 Draw typical drawing of river training works including spur	8
6	Water logging and drainage	6.1 Draw typical layout drawings of hill irrigation system	3
7	Hydrology and flood estimation	7.1 Calculate discharge from velocity method	4
8	Waterpower engineering	8.1 Draw typical drawing of layout plan of hydropower project	4
		Total	64

## 6. Learning Facilitation Process

Learning facilitation process is determined according to the content to be dealt in the subject. It's also an art of teacher. The teacher should utilize such teaching methods and techniques that are appropriate to the contents and needs of the students. In facilitating

the course, various approaches, methods and techniques are used. To be particular, the following major methods and strategies are used in this subject:

- Group Discussion
- Field Visit and report presentation
- Research
- Practical Works
- Demonstration
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, class-work, project work, practical works etc.	5

2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 9

Subjects : Water Resources Engineering

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction of irrigation	5	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	4
2	Water requirement	7																	5
3	Method of irrigation	8																	6
4	Various irrigation structures	10																	8
5	Canal	6																	5
6	Water logging and drainage	8																	6
7	Hydrology and flood estimation	10																	8
8	Waterpower engineering	10																	8
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

# **Grade : 10 (Ten)**

## **Building Construction and Drawing**

**Grade: 10**

**Credit hrs: 4**

**Working hrs: 128**

### **1. Introduction:**

Building Construction course is designed to provide knowledge and skills in building construction techniques and technology including earthquake resisting construction technology. It intends to provide skills and knowledge on preparing drawings and sketches of building components and also develops the skill and Practical knowledge on the temporary structures as well as basic knowledge of earthquake. On completion of this course the student will be able to recognize various construction materials that are essential in construction, select the quality materials for the use in construction test materials for quality, strength and durability and use available materials in their proper position and state. Engineering Drawing course provides students with a broad introduction to 2-dimensional computer-aided drawing and drafting (CADD) with a focus on civil engineering drawings. The course is an intensive introduction to the use of a computer aided design and drafting (CADD) system for the development of construction drawing and documentation. On completion of this course the students will be able to recognize various drawing develop the concept of reading the CAD.

This curriculum comprises of fundamental conceptual principles and practices, Components of building, substructure and superstructure, temporary constructions, cement and concrete construction, earthquake resistant features, introduction to engineering drawing/basic drafting concept, introduction to auto CAD course and hardware, auto CAD commands, features. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## 1. Competencies

On completion of the course, the students will have the following competencies:

1. Identify the different components of buildings.
2. Follow the steps of construction systematically.
3. Supervise and test on the workmanship and quality of materials to be used in construction.
4. Supervision of concrete work and structure work.
5. Acquire knowledge and skills on earthquake resistant building construction techniques.
6. Learn to use popular CAD software programs (Autodesk Auto CAD) to model construction projects.
7. Create basic Civil and Architectural drawings.
8. Understand basic terminology, component and elements of different engineering structures.
9. Learn the techniques of preparing drawings which are used for construction
10. Use of a Computer Aided Design and Documentation (CADD) system for the development of construction documentation.

## 1. Learning Outcomes

Unit	Content Area	Learning Outcomes
1.	Components of building	<b>1.1 Introduction to building</b> 1.1.1 Introduce building and Explain their types. 1.1.2 Recall loads on building. 1.1.3 State components of the building. 1.1.4 Discuss considerations in building design. <b>1.2 Foundation</b> 2.1.1 Define foundation. 2.1.2 Enlist function of foundation. 2.1.3 State requirements of good foundation. 2.1.4 Illustrate types of foundations.

		<p><b>1.3 Staircase</b></p> <p>1.3.1 Define staircase and classify it.</p> <p>1.3.2 Recite the technical terminologies of staircase.</p> <p>1.3.3 State requirement of good staircase.</p> <p>1.3.4 Discuss design criteria (except structural design).</p> <p><b>1.4 Doors/windows</b></p> <p>1.4.1 Introduce door/windows.</p> <p>1.4.2 Name parts of door/window.</p> <p>1.4.3 Locate door/window in a building.</p> <p>1.4.4 State terminologies related to door/windows.</p> <p>1.4.5 Describe different size and types of door/window.</p> <p>1.4.6 Define ventilator and sky lights.</p> <p><b>1.5 Roof/roof covering works</b></p> <p>1.5.1 Define roof.</p> <p>1.5.2 State requirements of roof.</p> <p>1.5.3 Describe types of roof.</p> <p><b>1.6 Ceiling works</b></p> <p>1.6.1 List purpose of ceiling.</p> <p>1.6.2 Name materials used in ceiling works.</p> <p>1.6.3 Enlist advantages and disadvantages of ceiling works.</p> <p><b>1.7 Flooring works</b></p> <p>1.7.1 Introduce flooring works.</p> <p>1.7.2 Explain types of flooring and state terminologies used.</p>
2.	Substructure and Super structure	<p>2.1 Discuss types of walls and state their functions.</p> <p>2.2 Illustrate general principles to be observed in stone masonry construction.</p> <p>2.3 Interpret choosing wall thickness, height to length ratio.</p> <p>2.4 State causes, sources and impact of dampness.</p>

		2.5 Discuss remedial measures to prevent dampness. 2.6 Name materials used for damp proofing.
3.	Temporary Constructions	3.1 Define shoring and name its types. 3.2 Define underpinning and explain its methods (Definition and methods). 3.3 Define scaffolding, explain its types and state uses. 3.4 Introduce formwork for slab/beam/column and rewrite the requirements of good formwork. 3.5 Explain the types of walls and write their functions.
4.	Cement and concrete construction	4.1 Name the constituents, mix and state the uses of Lime concrete. 4.2 Name the constituents, mix and state the uses of cement concrete. 4.3 Recall grading of fine and course aggregate. 4.4 Describe nominal mix and controlled mix or design mix. 4.5 Explain workability of concrete and water cement ratio. 4.6 Interpret methods of concrete mixing (hand mixing and machine mixing). 4.7 Enlist factors affecting strength of concrete. 4.8 Define bulking of sand. 4.9 Explain batching of concrete. 4.10 Describe storing of concrete materials. 4.11 Perform slump tests, write its procedure and uses. 4.12 Introduce RCC. <ul style="list-style-type: none"> <li>● Explain steel reinforcement.</li> <li>● List advantages of R.C.C.</li> <li>● Describe bar bending and placing schedule.</li> </ul>
5.	Earthquake resistant Features	5.1 Introduce Earthquake and rewrite its /Causes/Effects. 5.2 Explain building forms for earthquake resistance. 5.3 Describe importance of RCC bands in load bearing structure.

		5.4 Define plinth , Skill Stiches Lintel, roof and gable bands and innumerate their function, horizontal and vertical. 5.5 Discuss the location, size, and length of opening in masonry building.
6.	Introduction to engineering drawing/ Basic Drafting Concept	6.1 Explain types of drawings. 6.2 Draw engineering symbols and conventional signs. 6.3 Explain the use of By-laws and Building codes. 6.4 Draft and prepare foundation plans. 6.5 Differentiate Site plans and location plans. 6.6 Draft floor plans, elevations and sections.
7.	Introduction to AutoCAD course and hardware	7.1 Illustrate history of AutoCAD Release. 7.2 Name PC peripherals of AutoCAD and mention the system requirements. 7.3 Interpret the use of AutoCAD in civil engineering drawings. 7.4 Write procedures to start a new drawing in AutoCAD. 7.5 Write procedures to open an existing Drawing. 7.6 Draw screen layout of AutoCAD. Explain setting preferences in CAD.
8.	AutoCAD commands	8.1 Use and write the syntax of different drawing commands. 8.2 Use and write the syntax of different modify commands.
9.	Features	9.1 Explain view tools and inquiry commands. 9.2 Understand Layers concept and write syntax of match properties and change properties. 9.3 Write the syntax of measure and divide commands. 9.4 Write the syntax of Block, Wblock and external reference command. 9.5 Define Plotters/Printers. Write the procedure of plotting the drawing, Compare plotter and printer.

## 2. Scope and Sequence

Unit	Scope	Content	Hrs.
1.	Components of building	<p>1.1 Introduction to building</p> <p>1.1.1 Introduction to building and their types</p> <p>1.1.2 General idea on loads on building</p> <p>1.1.3 Components of the building</p> <p>1.1.4 Considerations in building design</p> <p>1.2 Foundation</p> <p>1.2.1 Definition of foundation</p> <p>1.2.2 Function of foundation</p> <p>1.2.3 Requirements of good foundation</p> <p>1.2.4 Types of foundations</p> <p>1.3 Staircase</p> <p>1.3.1 Definition and classification of staircase</p> <p>1.3.2 Technical terminology</p> <p>1.3.3 Requirement of good staircase</p> <p>1.3.4 Design criteria (except structural design)</p> <p>1.4 Doors/windows</p> <p>1.4.1 Introduction</p> <p>1.4.2 Parts of door/window</p> <p>1.4.3 Location of door/window</p> <p>1.4.4 Related terminologies</p> <p>1.4.5 Size and types of door/window</p> <p>1.4.6 Ventilator and sky lights</p> <p>1.5 Roof/roof covering works</p> <p>1.5.1 Definition</p> <p>1.5.2 Requirements of roof</p> <p>1.5.3 Types of roof (Pitched or sloping roof)</p> <p>1.6 Ceiling works</p>	12

		<p>1.6.1 Purpose of ceiling</p> <p>1.6.2 Materials used</p> <p>1.6.3 Advantages and disadvantages</p> <p>1.7 Flooring works</p> <p>1.7.1 Introduction to flooring works</p> <p>1.7.2 Types of flooring and terminologies used</p>	
2.	Substructure and Super structure	<p>2.1 Types of walls and their functions</p> <p>2.2 General principles to be observed in stone masonry construction</p> <p>2.3 Choosing wall thickness, height to length ratio</p> <p>2.4 Damp – proofing (causes, sources and impacts of dampness)</p> <p>2.5 Remedial measures to prevent dampness</p> <p>2.6 Materials used for damp proofing</p>	8
3.	Temporary constructions	<p>3.1 Shoring (Definition and Types)</p> <p>3.2 Underpinning (Definition and methods)</p> <p>3.3 Scaffolding (Definition, Types and uses)</p> <p>3.4 Formwork for slab/beam/column</p> <p>3.4.1 Introduction</p> <p>3.4.2 Requirements of good formwork</p> <p>3.5 Formwork for slab/beam/column</p> <p>3.6 Types of walls and their functions</p>	6
4.	Cement and concrete construction	<p>4.1 Lime concrete, constituents, mix and uses.</p> <p>4.2 Cement concrete – constituents and uses.</p> <p>4.3 Grading of fine and course aggregate</p> <p>4.4 Nominal mix and Controlled mix or design mix</p> <p>4.5 Workability of concrete and water cement ratio</p> <p>4.6 Methods of concrete mixing (hand mixing and machine mixing)</p> <p>4.7 Factors affecting strength of concrete</p>	10

		<p>4.8 Bulking of sand</p> <p>4.9 Batching of concrete</p> <p>4.10 Storing of concrete materials</p> <p>4.11 Slump tests its procedure and its uses</p> <p>4.12 Introduction to reinforced concrete</p> <p>4.12.1 Steel reinforcement</p> <p>4.12.2 Introduction and Advantages of R.C.C.</p> <p>4.12.3 Bar bending and placing schedule</p>	
5.	Earthquake resistant Features	<p>5.1. Introduction/Causes/Effects of earthquake</p> <p>5.2. Building Forms for earthquake resistance</p> <p>5.2.1 Building Configuration</p> <p>5.2.2 Height and Number of story</p> <p>5.2.3 Distribution of load bearing elements</p> <p>5.2.4 Location and size of openings</p> <p>5.3. Importance of RCC bands in load bearing structure (Horizontal Bands/Vertical Bands/Stitches).</p> <p>5.4. Discuss the location, size, and length of opening in masonry building.</p>	4
6.	Introduction to engineering drawing/ Basic Drafting Concept	<p>6.1 Introduction types of drawings</p> <p>6.2 Engineering symbols and conventional signs</p> <p>6.3 By-laws and Building codes</p> <p>6.4 Drafting and preparing foundation plans</p> <p>6.5 Site plans and location plans</p> <p>6.6 Floor plans, Elevations, Sections</p>	6
7.	Introduction to AutoCAD course and hardware	<p>7.1 Overview of AutoCAD Release</p> <p>7.2 Overview of a PC, peripherals e.g. printers and plotters, system settings</p> <p>7.3 Use of AutoCAD in civil engineering drawings</p> <p>7.4 Starting a new drawing.</p>	6

		7.5 Opening an existing Drawing 7.6 Screen layout of AutoCAD, Setting preferences (Setting Units and Scale, managing drawing area by using Multi-View Setup and Limits.)	
8.	AutoCAD commands	8.1 Drawing Commands 8.1.1 Co-ordinate input methods (directive, absolute, relative and polar) 8.1.2 Point, Lines, Polyline, Multiline, Construction Lines 8.1.3 Circle, Arc, Ellipse, Donut 8.1.4 Polygon, Rectangle, Spline, solids 8.1.5 Hatching, Text (multi-line & single line), Dimensions 8.2 Modify commands 8.2.1 Erase, Trim, Break 8.2.2 Copy, Mirror, Offset, Array 8.2.3 Length, Extend, Chamfer, Fillet	8
9.	Features	9.1 View tools and inquiry commands 9.2 Layers concept, match and change properties 9.3 Measure and divide commands 9.4 Working with Block, W-block and External References 9.5 Plotters and Plotting the drawing	4
	Total		64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Scope	Activities	Hrs.
1.	Components of building	1.1 Draw the various shallow foundation, column, dog legged stair, frame of door and window, roof.	6
2.	Temporary constructions	2.1 Erect/observe shoring, Underpinning, scaffolding, formwork.  *Arrange field visit to show different components of building	3
3.	Substructure and Super structure	3.1 Draw elevation of wall, brick and stone masonry.	4
4.	Cement and concrete construction	4.1 Perform steel cut, and bend. 4.2 Test for fineness of cement 4.3 Test for consistency of standard cement paste 4.4 Test for setting time of cement paste 4.5 Test for compressive strength of cement concrete 4.6 Slump test on concrete 4.7 Rebound hammer test on concrete to determine compressive strength of concrete	13
5.	Earthquake resistant features	5.1 Sketch plates of earth, epicenter, focus, building elevation. Footing, stone wall.	3
6.	Introduction to engineering drawing/Basic Drafting Concept	6.1 Draft foundation, floor plan, elevations, roof plan, site plan, location plan, schedule of door and window, electrical drawing, water supply and sanitary drawing, symbol and convention sign.	10
7.	Introduction to AutoCAD course and hardware	7.1 Setting up, create template file, drafting, opening, screen layout, setup dimension style	5
8.	AutoCAD commands	8.1 Practice different drawing commands, modify commands.	5
9.	Features	9.1 Practice inquiry commands, Layer, Block, Wblock commands, Plotting drawing. Use CAD to draw full architectural drawing of Building	15
Total			64

## 6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Group Discussion
- Demonstration
- Questionnaire
- Creative
- Practical Works
- Visit and report presentation
- Audio/Visual
- Case Study
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be

based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weight age. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

### Specification Grid

**Grade: 10**

**Subjects : Building Construction and Drawing**

**Time : 2 hrs.**

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Components of building	12	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	9
2	Substructure and Superstructure	8																	6
3	Temporary constructions	6																	5
4	Cement and concrete construction	10																	8
5	Earthquake resistant Features	4																	3
6	Introduction to engineering drawing/ Basic Drafting Concept	6																	5
7	Introduction to AutoCAD course and hardware	6																	5
8	AutoCAD commands	8																	6
9	Features	4																	3
	<b>Total</b>	<b>64</b>	<b>7</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>16</b>	<b>9</b>	<b>25</b>	<b>16</b>	<b>50</b>

# Highway Engineering

**Grades: 10**

**Credit hrs: 4**

**Working hrs: 128**

## **1. Introduction**

Highway engineering course provides basic knowledge and skills on Highway term and terminology. It types of road alignments, basic highway geometrics design and road construction techniques. It also deals about road construction equipments. It is main important for the supervision on road construction. It explains the general term of engineering highway.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, road alignment and survey, general definition of terms used in highway geometric design, highway materials, highway drainage, road pavement, road making machinery and its uses, road construction technology, Low cost roads, hill roads, NRS and feeder road guidelines. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

1. Develop a sense of model of transportation.
2. Describe about alignment & its survey.
3. Create idea about geometry design.
4. Identify the highway materials
5. Analyze about highway drainage .
6. Develop the knowledge of road pavement and road construction technology
7. Acquire skill for low cost roads

8. Develop knowledge of hill road
9. Create idea to use NRS & guidelines.

### 3. Grade wise learning Outcomes

Unit	Content Area	Learning outcomes
1	Introduction	1.1 Explore Different modes of transportation and Benefits of roads. 1.2 Throw light on Importance of roads for Nepal. 1.3 Classify roads according to NRS. 1.4 Describe Role of roads in rural development. 1.5 Introduce History of development of roads. 1.6 Differentiate and compare Rural and urban road, advantages and disadvantages. 1.7 Illustrate Types of feeder( Provincial and Local road) roads and overview in construction. 1.8 Recognize and draw different urban Road patterns.
2	Road alignment and survey	2.1 Describe Fundamental principles of alignment. 2.2 Point out Requirements of road alignment. 2.3 Explain Factors which control the selection of road alignment. 2.4 Describe Engineering survey for highway locations.
3	General definition of terms used in highway eometric design	3.1 Define Traffic volume, intensity, lane, slip friction, skid. 3.2 Explain Typical cross section in cutting and filling- definition of its elements. 3.3 Define Camber, super-elevation, extra-widening. 3.4 Explain Sight distance and its types. 3.5 Numerical practice on Extra widening and sight distance.
4	Highway materials	4.1 Describe Importance of soil engineering in road construction. 4.2 Explain Grading for road construction.

		<p>4.3 Explain Sub-grade soil, its importance and requirements for practical use.</p> <p>4.4 Define Stone aggregates, types and requirements.</p> <p>4.5 Describe Binding materials uses and requirements.</p>
5	Highway drainage	<p>5.1 Describe Drainage system, types and its importance.</p> <p>5.2 Point out Requirements of good drainage system.</p> <p>5.3 Describe Field construction procedures.</p>
6	Road pavement and Road making machineries with uses	<p>6.1 Explanations on Types of pavement – Flexible and Rigid pavement definitions.</p> <p>6.2 Detailed study on General structures of pavement-sub-grade, sub-base, base and surface courses uses.</p> <p>6.3 Measure Role of labor vs machinery in road construction.</p> <p>6.4 Explain Earthwork machinery types and uses.</p> <p>6.5 Describe Compaction equipment- Three wheeled road roller, Sheep foot rollers, Pneumatic tired roller, Vibratory rollers.</p> <p>6.6 Illustrate Transporting equipment's and Watering equipment.</p> <p>6.7 Explain Rock excavation machinery.</p> <p>6.8 Describe Production of aggregates.</p>
7	Road construction technology	<p>7.1 Describe Embankment construction.</p> <p>7.2 Describe earthen road construction.</p> <p>7.3 Describe Gravel road construction.</p> <p>7.4 Describe WBM road construction.</p> <p>7.5 Describe bituminous road construction.</p> <p>7.6 Describe Surface dressing, Otta seal.</p> <p>7.7 Rigid pavement construction procedures.</p>
8	Low cost roads and General introduction to bridges	<p>8.1 Introduce low cost road.</p> <p>8.2 Explain Types and field construction technology.</p> <p>8.3 Describe Advantages of stage construction of roads.</p>

		8.4 Definition on Bridge and its types (suspended and Suspension). 8.5 Illustrate the components of bridge.
9	Hill roads	9.1 Write Importance of hill roads and special considerations. 9.2 Define drainage, cross-slope, grade in hill road, hair-pin-bend etc. 9.3 Explain retaining walls, breast walls, revetment walls, toe walls and slope protection works.
11	NRS and Feeder road guidelines	10.1 Practice NRS and Feeder road guidelines. 10.1.1 Width of carriage ways. 10.1.2 Shoulders 10.1.3 Medians ,Camber, Super elevation. 10.1.4 Surface Drainage, Embankments, Side slopes. 10.1.5 Right of Way , Lateral and vertical clearances.

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Introduction	1.1 Different modes of transportation 1.2 Benefits of roads 1.3 Importance of roads for Nepal 1.4 Classification of roads according to NRS 1.5 Role of roads in rural development 1.6 History of development of roads 1.7 Rural and urban road, advantages and disadvantages 1.8 Types of feeder roads and overview in construction 1.9 Urban Road patterns	6

2.	Road alignment and survey	2.1 Fundamental principles of alignment 2.2 Requirements of road alignment 2.3 Factors which control the selection of road alignment 2.4 Engineering survey for highway locations	8
3	General definition of terms used in highway geometric design	3.1 Traffic volume, intensity, lane, slip friction 3.2 Typical cross section in cutting and filling- definition of its elements 3.3 Camber, super-elevation, extra-widening 3.4 Sight distance- definition and types 3.5 Numerical practice on extra widening and sight distance	8
4	Highway materials	4.1 Importance of soil engineering in road construction 4.2 Grading for road construction 4.3 Sub-grade soil, its importance and requirements for practical use 4.4 Stone aggregates, types and requirements 4.5 Binding materials uses and requirements	5
5	Highway drainage	5.1 Drainage system and its importance 5.2 Requirement of good drainage system 5.3 Field construction procedures	8
6	Road avement and Road making machinery with its uses	6.1 Types of pavement – Flexible and Rigid pavement definitions 6.2 General structures of pavement- sub-grade, sub-base, base and surface courses uses 6.3 Role of labor vs machinery in road construction 6.4 Earthwork machinery types and uses 6.5 Compaction equipment- Three wheeled road roller, Sheep foot rollers, Pneumatic tyred roller, Vibratory rollers	10

		6.6 Transporting equipment 6.7 Watering equipment 6.8 Rock excavation machinery 6.9 Production of aggregates	
7	Road construction technology	7.1 Embankment construction: Field procedures 7.2 Earthen road construction: Field procedures 7.3 Gravel road construction: Field procedures 7.4 WBM road construction: Filed procedures 7.5 Bituminous macadam road construction: Field procedures 7.6 Surface dressing, Otta seal: Field construction procedures. 7.7 Rigid pavement: Field construction/ process).	8
8	Low cost roads	8.1 Introduction 8.2 Types and field construction technology 8.3 Advantages of stage construction of roads 8.4 Introduction to bridges, types (Suspension and suspended) 8.5 Components of bridges	4
9	Hill roads	9.1 Importance of hill roads and special considerations 9.2 Terminologies used in hill roads as drainage, cross-slope, grade in hill road, hair-pin-bend etc. 9.3 Special structures such as retaining walls, breast walls, revetment walls, toe walls and slope protection works	5
10	NRS and Feeder road guidelines	10.1 NRS and Feeder road guidelines 10.1.1 Width of carriage ways 10.1.2 Shoulders 10.1.3 Medians ,Camber , Super elevation	2

		10.1.4 Surface Drainage, Embankments, Side slopes 10.1.5 Right of Way , Lateral and vertical clearances	
		Total	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Scope	Practical Activities	Hrs.
1	Introduction	1.1 Arrange site visits in nearby localities to make familiar with road patterns and road types.	6
2	Road alignment and survey	2.1 Carry out road alignment study based on contour map of existing roads. 2.2 Fix a new alignment on the contour map. 2.3 Prepare the longitudinal profile and cross section of the alignment	6
3	General definition of terms used in highway geometric design	3.1 Arrange site visits to observe the different elements of road geometrics. 3.2 Set out road curves, super-elevation, cambers and extra widening for different situational traffic junctions.	6
4	Highway materials	4.1 Sensitize with road stone, soils and binding materials. 4.2 Execute field density test of soil 4.3 Execute sieve analysis and grading of soil, aggregate or based method 4.4 Perform OMC test	10

5	Highway drainage	5.1 Arrange field visit to show different road drainage types 5.2 Set out of different road drainage in given gradients.	9
6	Road pavement and Road Making machineries with its uses	6.1 Draw longitudinal and cross sections of road with the elements of pavement 6.2 Arrange a field visit to show pavements types and pavement elements. 6.3 Identify different road construction equipment 6.4 Arrange a field trip to illustrate road equipment in governmental / non-governmental construction institutions. 6.5 Arrange field trips to observe the operation of road equipment at the time of construction in nearby locations.	8
7	Road construction technology	7.1 Sensitize different types of road construction technology 7.2 Set out road embankment	7
8	Hill roads	8.1 Draw free hand sketch of hill road with elements 8.2 Arrange a field trip to visit and observe hill road elements.	9
9	NRS and Feeder road guidelines	9.1 Use NRS and Feeder Road Guidelines	3
	Total		64

## 6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In particular, the teacher can make use of

the following methods and strategies for the learning facilitation:

- Visual Class
- Field Visit and report presentation
- Group Discussion
- Case study
- Questionnaire
- Practical Works
- Research
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5

2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 10

Subjects : Highway Engineering

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	6																	5
2	Road alignment and survey	8																	6
3	General definition of terms used in highway geometric design	8																	6
4	Highway materials	5																	5
5	Highway drainage	8																	6
6	Road pavement and Road making machinery with its uses	10																	8
7	Road construction technology	8																	6
8	Low cost roads	4	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	2
9	Hill roads	5																	5
10	NRS and Feeder road guidelines	2																	1
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

# Engineering Surveying- I

**Grades: 10**

**Credit hrs: 4**

**Working hrs: 128**

## **1. Introduction**

This course is designed to impart knowledge and skills on introductory surveying, Measurement of distance, Reliability of survey, Chain surveying and Compass surveying. After completion of this course student will be able to develop plan and map. Students will be able to select the suitable methods of measurements and prepare themselves as skill manpower for the measurement of any area.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, measurement of distance, reliability of survey, chain survey, compass survey. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

1. Develop Knowledge of measurement system.
2. Create idea about unit conversion.
3. Develop the Knowledge of Error and its types.
4. Create idea to develop surveying of any area by Chain.
5. Acquire the skill of using of Prismatic Compass

### 3. Grade wise learning Outcomes

Unit	Content Area	Learning outcomes
1	Introduction	1.1 Define Surveying 1.2 Write Objective of Surveying 1.3 write Uses of Surveying 1.4 Classify Surveying 1.5 Describe Principles of Surveying 1.6 Define Full Size Scale, Reducing Scale, and Enlarging Scale 1.7 Determine Representative Fraction, diagonal scale, Comparative scale. 1.8 Explain Plain Scale, and Venire Scale 1.9 Practice Numerical
2	Measurement of Distance	2.1 Accessories for Distance Measurements – Chain and Tape, Arrow and Peg, Ranging Rods, Plum Bob, and Abney Level. 2.2 Types of Chains – Gunter’s Chain, Engineer’s Chain and Metric Chain 2.3 Types of Tapes – Cloth or Linen Tape, Metallic Tape, Steel Tape and Invar Tape 2.4 Ranging 2.5 Horizontal Distance Measurement on Plain Ground 2.6 Horizontal Distance Measurement on Sloping Ground 2.7 Unit of Measurement 2.8 Unit Conversion 2.9 Conversion Table for Important Units 2.10 Chain and Tape corrections – Temperature Correction, Pull Correction, Sag Correction 2.11 Numerical practice
3	Reliability of Survey	3.1 Accuracy Required 3.2 Error

		<p>3.3 Types of error – Mistakes, Compensating error, cumulative error.</p> <p>3.4 Precision</p> <p>3.5 Correction</p>
4	Chain Survey	<p>4.1 Principles of Chain Surveying</p> <p>4.2 Suitability of Chain Surveying</p> <p>4.3 Unsuitability of Chain Surveying</p> <p>4.4 Well - conditioned Triangles and Ill - conditioned Triangles</p> <p>4.5 Survey Stations – Main Stations, Subsidiary Stations and Tie Stations</p> <p>4.6 Reconnaissance Survey – Preparation of Index Sketch, Selection of Survey Stations, Location Sketch of Survey Stations</p> <p>4.7 Survey Lines – Main Survey Lines, Base line, Check Line, and Tie line</p> <p>4.8 Offsets – Perpendicular Offsets, Oblique Offsets</p> <p>4.9 Field Book – Single Line Field Book and Double Line Field Book</p> <p>4.10 Conventional Symbols</p> <p>4.11 Procedure of Plotting a Chain Survey</p> <p>4.12 Numerical practice</p>
5	Compass Survey	<p>5.1 Principles of Compass Surveying</p> <p>5.2 Traversing</p> <p>5.3 Types of Traverse – Closed Traverse, and Open or Unclosed Traverse</p> <p>5.4 Types of Compass – Prismatic Compass, and Surveyor's Compass</p> <p>5.5 Comparison between Prismatic Compass and Surveyor's Compass</p>

		<p>5.6 Meridian – True Meridian, Magnetic Meridian, and Arbitrary Meridian</p> <p>5.7 Magnetic Declination</p> <p>5.8 Bearings – True Bearing, Magnetic Bearing, and Arbitrary Bearing,</p> <p>5.9 Bearing System - Whole Circle Bearing System, and Quadrantal Bearing System</p> <p>5.10 Fore Bearing and Back Bearing</p> <p>5.11 Local Attraction</p> <p>5.12 Calculation of Angles from Bearings</p> <p>5.13 Calculation of Bearings from Angles</p> <p>5.14 Numerical practice</p>
6	Leveling	<p>6.1 Define the term use in leveling- Leveling, Datum, Bench mark(Permanent, temporary, Arbitrary), Reduce level, line of collimation, back sight, intermediate sight, change point or turning point</p> <p>6.2 Explain classification of leveling – Simple leveling and Differential leveling</p> <p>6.3 Types of level – Dumpy level, Tilting level and automatic level</p> <p>6.4 Temporary adjustment of level-setting up the level, leveling up, elimination of parallax(focusing the eye-piece, focusing the objective)</p> <p>6.5 Explain Booking and reduction of levels – Rise Fall Method and Height of instrument method</p> <p>6.6 Explain uses of leveling-longitudinal section, cross section Contouring and setting out levels</p> <p>6.7 Two peg test</p> <p>6.8 Fly leveling</p> <p>6.9 Reciprocal leveling</p>

		6.10 Curvature and refraction correction
		6.11 Plotting-longitudinal section, cross sections
		6.12 Errors in leveling-instrumental error, personal error, natural error
		6.13 Numerical practice

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Introduction	1.1 Definition of Surveying 1.2 Objective of Surveying 1.3 Uses of Surveying 1.4 Classification of Surveying 1.5 Basic Principles of Surveying 1.6 Definition of scale- Full Size Scale, Reducing Scale, and Enlarging Scale 1.7 Representative Fraction 1.8 Types of Scale – Plain Scale, diagonal scale, scale of chord and Vernier Scale 1.9 Numerical practice	7
2.	Measurement of Distance	2.1 Accessories for Distance measurements- Chain and Tape, Arrow and Peg, Ranging Rods, Plum Bob, and Abney Level. 2.2 Types of Chains – Gunter’s Chain, Engineer’s Chain and Metric Chain 2.3 Types of Tapes – Cloth or Linen Tape, Metallic Tape, Steel Tape and Invar Tape 2.4 Ranging 2.5 Classification of ranging 2.6 Horizontal Distance Measurement on Plain Ground 2.7 Horizontal Distance Measurement on Sloping Ground	10

		<p>2.8 Unit of Measurement</p> <p>2.9 Conversion Table for Important Units</p> <p>2.10 Chain and Tape corrections ,temperature correction, pull correction, sag correctionand slope correction</p> <p>2.11 Numerical practice</p>	
3	Reliability of Survey	<p>3.1 Accuracy Required</p> <p>3.2 Error</p> <p>3.3 Types of error – Mistakes, Compensating error, cumulative error.</p> <p>3.4 Precision</p> <p>3.5 Correction</p>	6
4	Chain Survey	<p>4.1 Principles of Chain Surveying</p> <p>4.2 Suitability of Chain Surveying</p> <p>4.3 Unsuitability of Chain Surveying</p> <p>4.4 Well - conditioned Triangles and Ill - conditioned Triangles</p> <p>4.5 Survey Stations – Main Stations, Subsidiary Stations and Tie Stations</p> <p>4.6 Reconnaissance Survey – Preparation of Index Sketch, Selection of Survey Stations, Location Sketch of Survey Stations</p> <p>4.7 Survey Lines – Main Survey Lines, Base line, Check Line, and Tie line</p> <p>4.8 Offsets – Perpendicular Offsets, Oblique Offsets</p> <p>4.9 Procedure of chain survey – Reconnaissance, selection of survey station and survey lines, referencing and marking of stations and detailing</p> <p>4.9 Field Book – Single Line Field Book and Double Line Field Book</p> <p>4.10 Conventional Symbols</p> <p>4.11 Procedure of Plotting a Chain Survey</p>	10

5	Compass Survey	5.1 Principles of Compass Surveying 5.2 Traversing 5.3 Types of Traverse – Closed Traverse, and Open or Unclosed Traverse 5.4 Types of Compass – Prismatic Compass, and Surveyor’s Compass 5.5 Comparison between Prismatic Compass and Surveyor’s Compass 5.6 Meridian - True Meridian, Magnetic Meridian, and Arbitrary Meridian 5.7 Magnetic Declination 5.8 Bearing- True Bearing, Magnetic Bearing, and Arbitrary Bearing, 5.9 Bearing system- Whole Circle Bearing System, and Quadrantal Bearing System 5.10 Fore Bearing and Back Bearing 5.11 Local Attraction 5.12 Method of elimination of local attraction 5.12 Calculation of Angles from Bearings 5.13 Calculation of Bearings from Angles 5.14 Sources of error in compass survey 5.14 Numerical practice	15
6	Leveling	2.1 Definitions of the terms used in Leveling – Leveling, Datum, Bench Mark (Permanent, Temporary, Arbitrary), Reduced Level, Line of Collimation, Back Sight, Fore Sight, Intermediate Sight, Change Point or Turning Point 2.2 Principle of Leveling – Simple Leveling, and Differential Leveling 2.3 Types of Level – Dumpy Level, Tilting Level, Automatic Level	16

		2.4 Temporary Adjustment of Level – Setting up the Level, Leveling up, Elimination of Parallax (Focusing the Eye-piece, Focusing the Objective)	
		2.5 Booking and Reduction of Levels– Rise and Fall Method, and Height of Instrument Method	
		2.6 Uses of Leveling – Longitudinal Sections, Cross Sections, Contouring, Setting out Levels	
		2.7 Two Peg Test	
		2.8 Fly Leveling	
		2.9 Reciprocal Leveling	
		2.10 Curvature and Refraction Correction	
		2.11 Plotting - Longitudinal Sections, Cross Sections	
		2.12 Errors in Leveling – Instrumental Error, Personal Error, Natural Error	
		2.13 Numerical Practice	
	<b>Total</b>		<b>64</b>

### 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Scope	Practical Activities	Hrs.
1	Introduction	1.1 Practice Representative Fraction 1.2 Practice Scale Conversion	5
2	Measurement of Distance	2.1 Perform Ranging to Measure Distance 2.2 Measure Horizontal Distance on Plain Ground 2.4 Measure Horizontal Distance on Sloping Ground 2.5 Practice Conversion Table for Important Units	7

		2.6 Perform and Compute Chain and Tape corrections – Temperature Correction, Pull Correction, Sag Correction	
3	Reliability of Survey	3.1 Determine Degree of Accuracy in Chaining 3.2 Determine Degree of Accuracy in Taping 3.3 Compute Error in Chaining and Taping 3.4 Determine Precision 3.5 Compute Correction	7
4	Chain Survey	4.1 Perform Field Procedure of Chain Survey – Reconnaissance (Preparation of Index Sketch, Selection of Survey Stations, Location Sketch of Survey Stations), Taking offsets of ground points 4.2 Establish Survey Lines – Main Survey Lines, Base line, Check Line, and Tie line 4.3 Perform Offsets – Perpendicular Offsets, Oblique Offsets 4.4 Record Field Book – Single Line Field Book and Double Line Field Book 4.5 Perform chain triangulation and detailing	15
5	Compass Survey	5.1 Introduce Principle of Operation of Compass – Prismatic Compass, and Surveyor’s Compass 5.2 Practice Comparison between Prismatic Compass and Surveyor’s Compass 5.3 Practice Bearing System - Whole Circle Bearing System, and Quadrantal Bearing System 5.4 Practice Fore Bearing and Back Bearing 5.5 Determine and Compute Local Attraction 5.6 Perform Compass Traversing and detailing 5.7 Perform Reconnaissance Survey – Preparation of Index Sketch, Selection of Survey Stations, Location Sketch of Survey Stations 5.8 Practice Calculation of Angles	14

		5.9 Practice Calculation of Bearings	
		5.10 Perform Procedure of Plotting a Compass Survey	
6	Levelling	6.1 Perform leveling	16
		6.2 Two peg test	
		6.3 Fly leveling	
		6.4 Profile leveling and cross sectioning	
		6.5 Reciprocal levelling	
Total			64

## 6. Learning Facilitation Method and Process

Learning facilitation process is the crux of the teaching and learning activity. One topic can be facilitated through two or more than two methods or processes. The degree of usage will be based on the nature of the content to be facilitated. However, a teacher should focus on methods and techniques that are more students centered and appropriate to facilitate the content. The following facilitation methods, techniques and strategies will be applied while conducting the teaching learning process:

- Demonstration
- Practical Works
- Demonstration
- Report presentation
- Questionnaire
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

**(a) Internal Evaluation**

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
<b>Total</b>			<b>50</b>

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the

specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 10

Subjects : Engineering surveying

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	5	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	5
2	Measurement of Distance	7																	5
3	Reliability of Survey	7																	5
4	Chain Survey	15																	12
5	Compass Survey	14																	11
6	levelling	16																	12
	<b>Total</b>	<b>64</b>	<b>7</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>16</b>	<b>9</b>	<b>25</b>	<b>16</b>	<b>50</b>

# Estimation Costing and Supervision- I

**Grades: 10**

**Credit hrs: 4**

**Working hrs: 128**

## 1. Introduction

Estimation costing and supervision course is designed to provide basic knowledge to estimate and costing finding of the project. After completion of this course students will be able to make implementation of a design, estimating of a building and prepare rate analysis and construction management.

This curriculum comprises of fundamental conceptual principles and practices, definition of estimating, area and volume calculation, earthwork calculation, estimate quantity of masonry footings, estimating of simple super structure wall, estimating of concrete flooring, estimating simple RCC works, estimating of plastering, punning and pointing works, estimating of one, two and multi room building, estimating of road pavements, rate analysis for earthwork in excavation, rate analysis for PCC works, rate analysis for steel reinforcement works, rate analysis for brick work, quotation and tender documents, supervision works, construction site management, prepare log book, prepare muster roll, measurement of works, measurement book, preparing running bill, basic principle of construction management, scheduling of task and layout work. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Develop a sense of estimating, costing and supervision.
2. Create idea to develop estimating, costing and supervision.

3. Acquire skills to prepare supervision plan.
4. Apply idea to estimate earthwork.
5. Acquire skill to estimate simple RCC work.
6. Develop idea to estimate plaster, punning and pointing works.
7. Acquire skill to estimate CGI Sheet work, Multi room building, Break pressure tank, road pavement, culvert, PCC work, steel reinforcement, brickwork.
8. Develop skill to prepare tender documents, supervision, and management.
9. Acquire skill to develop the work book, bill and scheduling.
10. Develop idea to prepare rate analysis of different items of works.

### 3. Grade wise learning Outcomes

Unit	Content area	Learning outcomes
1.	Definition of estimating	1.1 Define estimate 1.2 Write importance of estimate 1.3 Write types of estimate 1.4 Practice different items of works and their units of measurement 1.5 Define system of measurement 1.6 Practice conversion of systems of units
2.	Area and volume calculation	2.1 Define sectional area of regular trenches 2.2 Define sectional areas of irregular trenches 2.3 Calculate regular and irregular simple volumes. 2.4 Write estimating format 2.5 Practice methods of earthwork calculation
3	Estimate quantity of masonry footings & super structure wall	3.1 Draw masonry footing 3.2 Write items of works for footing construction 3.3 Draw simple super structure wall 3.4 Calculate quantity of single room 3.5 Identify deduction items 3.6 Draw simple concrete flooring works 3.7 Determine density of steel & concrete

		<p>3.8 Draw reinforcement details of simple beam, lintel, column &amp; slab</p> <p>3.9 Find out reinforcement spacing, bends, hooks and development length</p> <p>3.10 Estimate simple RCC works</p> <p>3.11 Define plastering, punning &amp; pointing works</p> <p>3.12 Estimate plastering, pointing &amp; punning works</p> <p>3.13 Draw one, two, &amp; multi room building (plan, elevation, section)</p>
4	Rate Analysis	<p>4.1 Define rate analysis</p> <p>4.2 Write GON norms and current district rates</p> <p>4.3 Define overhead, water charge, tools and plants, profit and vat.</p> <p>4.4 Define man and materials consumption</p> <p>4.5 Practice ratios of PCC in practice</p> <p>4.6 Calculate dry volume and wet volume of ingredients</p> <p>4.7 Draw structure drawing showing steel reinforcement</p> <p>4.8 Prepare rate analysis of reinforcement bar</p> <p>4.9 Calculate brick work for cubic meter work</p> <p>4.10 Practice ratios in mortars (1:4, 1:6)</p>
5	Quotation and tender documents	<p>5.1 Define quotation and tender</p> <p>5.2 Define quotation and tender documents</p> <p>5.3 What are the conditions of contract</p> <p>5.4 Write types of contract</p> <p>5.5 Prepare contract award procedure</p>
6	Supervision works	<p>6.1 Define supervision and supervisor's roles</p> <p>6.2 Write duties of supervisor</p> <p>6.3 Discuss interrelationship among client, consultant and contractors</p>
7	Construction site anagement	<p>7.1 Draw major components of construction site (site office, store, fabrication yard, worker accommodation, toilets)</p> <p>7.2 Define site logistcs</p>

		7.3 Define site utilities (telephone, water supply, electricity) 7.4 Define surface drainage and sanitation 7.5 Define site safety
8	Prepare log book & muster roll	8.1 Define Log book and its uses 8.2 Prepare Format of log book 8.3 Define Muster roll 8.4 Write types of workers
9	Measurement book & billing process	9.1 Define measurement book 9.2 Write about importance of M.B. 9.3 Write Size of MB 9.4 Definite bill of quantities (BOQ) 9.5 Definite abstract of cost 9.6 Write procedure of running bill payment
10	Layout work	10.1 Write procedure for the layout of the building. 10.2 Write equipment required for building layout 10.3 Preparation before layout

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Definition of estimating	1.1 Definition of estimate 1.2 Importance of estimate 1.3 Types of estimate 1.4 Different items of works and their units of measurement 1.5 System of measurement 1.6 Conversion of systems of units	3
2.	Area and volume calculation	2.1 Sectional area of regular trenches 2.1 Sectional areas of irregular trenches 2.3 Calculation of regular and irregular simple volumes. 2.4 Estimating format 2.5 Methods of earthwork calculation	4

3	Estimate quantity of masonry footings & super structure wall	3.1 Drawing of masonry footing 3.2 Items of works for footing construction 3.3 Drawing of simple super structure wall 3.4 Estimate of single room building 3.5 Deduction items 3.6 Drawing of simple concrete flooring works 3.7 Density of steel, concrete, brick, stone, block etc. 3.8 Reinforcement details of simple beam, lintel, column & slab 3.9 Reinforcement spacing, bends, hooks and development length 3.10 Estimate of simple RCC works 3.11 Define plastering, punning & pointing works 3.12 Estimate plastering, pointing & punning works 3.13 Draw & estimate two & multi room building (plan, elevation, section) *arrange field trip to familiar foundation, superstructure, culvert etc.*	20
4	Rate Analysis	4.1 Define rate analysis 4.2 GON norms and current district rates 4.3 Define overhead, water charge, tools and plants, profit and VAT. 4.4 Man and materials consumption 4.5 Ratios of PCC in practice (1:3:6, 1:2:4) 4.6 Calculations of dry volume and wet volume of ingredients 4.7 Rate analysis of E/W, PCC, Form works, Plastering, reinforcement bar etc. 4.8 Calculations of a cubic meter of brick work 4.9 Ratios in mortars (1:4, 1:6)	10

5	Quotation and tender documents	5.1 Define quotation and tender 5.2 Quotation and tender documents 5.3 Conditions of contract 5.4 Types of contract 5.5 Contract award procedure	4
6	Supervision works	6.1 Definition of supervision and supervisor's roles 6.2 Duties of supervisor 6.3 Interrelationship among client, consultant and contractors	4
7	Construction site management	7.1 Major components of construction site (site office, store, fabrication yard, worker accommodation, toilets) 7.2 Site logistics 7.3 Site utilities (telephone, water supply, electricity) 7.4 Surface drainage and sanitation 7.5 Site safety	5
8	Prepare log book & muster roll	8.1 Log book and its uses 8.2 Format of log book 8.3 Definition of Muster roll 8.4 Types of workers	5
9	Measurement book & billing process	9.1 Definition of measurement book (M.B.) 9.2 Importance of M.B. 9.3 Size of MB 9.4 Definition of bill of quantities (BOQ) 9.5 Definition of abstract of cost 9.6 Procedure of running bill payment	5
10	Layout work	10.1 Procedure for the layout of the building. 10.2 Equipment required for building layout 10.3 Preparation before layout	4
Total			64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Scope	Practical Activities	Hrs.
1.	Definition of estimating	1.1 Convert units from one system to other system, Practice on units of measurement for different items of construction works	3
2.	Area and volume calculation	2.1 Calculate area of different regular/ irregular geometrical shapes, Calculate area of different regular geometrical solids	4
3	Estimate quantity of masonry footings & super structure wall	3.1 Prepare working drawing, Write job specification, Prepare format for estimate and Practice on different methods of filling up the format 3.2 Prepare working drawing and job specification, Calculate quantity for masonry work. 3.3 Prepare working drawing and job specification, Estimate quantity of wall, Estimate quantity to be deducted. 3.4 Prepare working drawing and job specification, Estimate quantity of concrete flooring works. 3.5 Prepare working drawing and job specification, Estimate the quantity of steel and concrete for simple beam, lintel column and slab. 3.6 Prepare drawing and job specification, Estimate the quantity of plastering/ punning/ pointing 3.7 Prepare drawing and job specification, Estimate quantity of roofing sheet 3.8 Prepare working drawing and job specification, Estimate a single roomed building, Estimate a double roomed building, Estimate a multi roomed building	24

		3.9 Prepare a working drawing and job specification, Estimate the quantity break pressure tank 3.10 Prepare a working drawing and job specification, Estimate the quantity tap stand 3.11 Prepare longitudinal and cross sectional profile, Estimate the earth work in cutting and filling 3.12 Prepare working drawing of slab culvert / arch culvert, Estimate the quantity a slab culvert/ pipe culvert	
4	Rate Analysis	4.1 Analyze rate for different job specifications as per NG norms in earthwork excavation 4.2 Analyze rate for PCC works in 1:2:4 for slab, beam and column. 4.3 Analyze rate for steel reinforcement in RCC works 4.4 Analyze rate for brick work of wall thickness half brick, one brick and one and half brick 4.5 Analyze rate for brick work of wall thickness half brick, one brick and one and half brick	10
5	Quotation and tender documents	5.1 Prepare Tender / Quotation notice and document, Sensitize tender/ quotation award procedure.	4
6	Construction site management	6.1 Prepare the layout of construction site showing major components.	5
7	Prepare log book & muster roll	7.1 Prepare Muster roll format, Practice on entering the Muster roll	5
8	Measurement book & billing process	8.1 Prepare measurement book, Practice on entering data on MB 8.2 Prepare running bills.	5
9	Layout work	9.1 Prepare the layout of a simple building.	4
		Total	64

## 6. Learning Facilitation Process

Learning facilitation process is determined according to the content to be dealt in the subject. It's also an art of teacher. The teacher should utilize such teaching methods and techniques that are appropriate to the contents and needs of the students. In facilitating the course, various approaches, methods and techniques are used. To be particular, the following major methods and strategies are used in this subject:

- Demonstration
- Field Visit and report presentation
- Case study
- Assignment Case study
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 10

Subjects : . Estimation Costing and Supervision-I

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks				
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long					
1	Definition of estimating	3	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	2				
2	Area and volume alculuation	4																					3
3	Estimate quantity of asonry footings &super structure wall	20																					16
4	Rate Analysis	10																					8
5	Quotation and tender ocuments	4																					3
6	Supervision works	4																					3
7	Construction site anagement	5																					4
8	Prepare log book & muster roll	5																					4
9	Measurement book & illing process	5																					4
10	Layout work	4																					3
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50				

# English

**Grade: 11 and 12**

**Subject code:**

**Eng. 003 (Grade 11)**

**Eng. 004 (Grade 12)**

**Credit hour: 4**

**Annual working hour: 128**

## 1. Introduction

English is a lingua franca and is an appropriate international language for Nepal to be connected with global community. It is not only the language of international communication but also a language of higher education, mass media, information and communication technology (ICT), business, tourism, science and medicine. In the context of Nepal, English is necessary for various purposes. To be specific, our learners need English to participate in classroom interactions; to study course materials; to read things for pleasure and general information; to gain access to the world body of knowledge; to read and enjoy a wide range of literary texts, to participate in international meetings, seminars and conferences; to communicate with foreigners in general; to enhance their career development, and many more. English is taught as a compulsory subject from grade one to the bachelors level.

Ministry of Education, Science and Technology (MoEST) has approved the National Curriculum Framework (NCF), 2076 addressing the changed socio-political condition of the country and the current needs of the learners. This grade 11 and 12 English curriculum has been developed in line with the spirit of the new NCF. The present curriculum addresses all four language skills with prime focus on reading and writing skills. It focuses on the types of reading and writing skills that are necessary for the students in their real life. It also includes the language functions which the students need for their further studies and the world of work. A strong grammatical foundation is also given due consideration in this curriculum. This curriculum is based on the principle that learners learn language when they get sufficient opportunity to use it in appropriate contexts. Content should not be detached from the use of language. Content and language should be integrated while teaching. Therefore, the curriculum has focused not only on language and language functions, but also on a variety of fiction and non-fiction texts which provide a meaningful context for language learning. For some students, secondary education serves as a basis for preparation for the university education, whereas for some other students, it may be a preparation for entry into the world of work. This curriculum tries to address the linguistic requirements of both types of students.

This curriculum focuses on both the intensive reading of texts which is intended for

language development in the learners and the extensive reading of texts which is intended for processing content and developing higher order reading and writing skills. Soft skills including critical thinking and creativity of the students have also been given due importance. For this purpose, a wide variety of texts have been included under various themes and topics. This curriculum includes level-wise competencies of students, grade-wise learning outcomes, scope and sequence of contents, learning facilitation process and evaluation process.

## **2. Competencies**

This curriculum of Grade 11 and 12 in English language aims at developing the following competencies in the learners:

1. Use both spoken and written English for general and academic purposes in a variety of personal, social and academic contexts.
2. Read a wide variety of texts for information and understanding.
3. Read a variety of literary texts for pleasure and appreciation.
4. Read, reflect and interpret a wide range of texts.
5. Critically analyze and evaluate ideas in a wide range of level appropriate texts.
6. Search, select and manage information from various textual and online sources.
7. Create a variety of writing for different purposes and audiences with appropriate content, style and accuracy.
8. Produce a variety of creative and critical writings.
9. Appreciate diverse cultures.
10. Listen and respond in English with accuracy and fluency
11. Communicate clearly and effectively in a range of situations using verbal and non-verbal communication strategies.

## **3. Grade-wise Learning Outcomes**

The learning outcomes in this curriculum are distributed between grade eleven and twelve based on their levels of difficulty. However, the same learning outcomes may be introduced in grade eleven and consolidated in grade twelve. Therefore, these may go in a sequence and will be addressed in the resource materials and pedagogy.

### 3.1 Listening

Listening constructs	Learning outcomes	
	Grade 11	Grade 12
1. Identify and discriminate stress and intonation patterns.	<ul style="list-style-type: none"> <li>▪ Identify the speaker's attitudes and feelings through their use of stress and intonation.</li> <li>▪ Show an understanding of differentiating tones (warnings, advice, suggestion, etc. ).</li> <li>▪ Identify the effects of supra-segmental features in a connected speech.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify the speaker's attitudes and feelings through their use of stress and intonation.</li> <li>▪ Identify the speaker's purpose by distinguishing tone and intonation patterns.</li> <li>▪ Identify the effects of supra-segmental features and phonological processes in a connected speech.</li> <li>▪ Identify the key words and phrases in the given text.</li> <li>▪ 1.5 Identify the differences between formal and informal English.</li> </ul>
2. Listen to the spoken text and understand its gist and retrieve specific information from it.	<ul style="list-style-type: none"> <li>▪ Identify the gist of a listening text.</li> <li>▪ Retrieve specific information from spoken English.</li> <li>▪ Compare and contrast information.</li> <li>▪ Show an understanding of the functions of common discourse markers.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify the gist, main idea and supporting details of a listening text.</li> <li>▪ Retrieve specific information from spoken English, and take notes.</li> <li>▪ Compare and contrast information.</li> <li>▪ Distinguish between cause and effect.</li> <li>▪ Interpret information and auditory cues.</li> <li>▪ Show an understanding of the functions of a wide range of discourse markers.</li> </ul>

<p>3. Make inference while listening</p>	<ul style="list-style-type: none"> <li>▪ Make predictions about the subsequent content using prior knowledge, phonological clues and contextual clues.</li> <li>▪ Make inference about themes and message of the spoken text from prior knowledge and contextual clues.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Make predictions about the subsequent content, actions and events using prior knowledge, phonological clues and contextual clues.</li> <li>▪ Make inference about purpose, intentions, themes and message of the spoken text from prior knowledge and contextual clues.</li> </ul>
<p>4. Listen to the spoken text and critically analyse and evaluate the information in it.</p>	<ul style="list-style-type: none"> <li>▪ Distinguish between facts and opinions in a spoken text.</li> <li>▪ Draw conclusions from main ideas, specific details, prior knowledge and contextual clues.</li> <li>▪ Identify the content and organisation of presentations.</li> <li>▪ Form opinions about ideas presented in listening texts.</li> <li>▪ Understand the meaning of common idiomatic expressions.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Separate facts from opinions in a spoken text.</li> <li>▪ Draw conclusions from main ideas, specific details, prior knowledge and contextual clues.</li> <li>▪ Identify different points of view and make judgment.</li> <li>▪ Make judgment on the relevance of spoken message.</li> <li>▪ Evaluate the content and organisation of presentations.</li> <li>▪ Form and interpret opinions about ideas presented in texts.</li> <li>▪ Understand and interpret the meaning of common and grade appropriate idiomatic expressions.</li> </ul>
<p>5. Listen to the spoken text and take note of important information.</p>	<ul style="list-style-type: none"> <li>▪ Listen to a variety of audio materials (e.g. lectures, conversations, personal accounts, narratives and</li> </ul>	<ul style="list-style-type: none"> <li>▪ Listen to a variety of audio materials (e.g. lectures, conversations, personal accounts, narratives and</li> </ul>

	<p>explanations) and take notes of them.</p> <ul style="list-style-type: none"> <li>Restate what has been heard.</li> </ul>	<p>explanations) and take notes of them.</p> <ul style="list-style-type: none"> <li>Restate what has been heard.</li> </ul>
6. Participate actively and effectively in an interaction.	<ul style="list-style-type: none"> <li>Participate as an active listener in an interaction and discussion.</li> <li>Ask for clarification and elaboration.</li> <li>Respond to the speaker with appropriate facial expressions and gestures.</li> <li>Respect the age, gender, social position and cultural traditions of the speaker.</li> </ul>	<ul style="list-style-type: none"> <li>Participate as an active listener in an interaction and discussion.</li> <li>Ask for clarification and elaboration.</li> <li>Respond to the speaker with appropriate facial expressions and gestures.</li> <li>Respect the age, gender, social position and cultural traditions of the speaker.</li> <li>Collaborate with others in order to explore and discuss understanding of spoken texts.</li> </ul>
7. Listen to instructions, directions and announcements and follow them.	<ul style="list-style-type: none"> <li>Show an understanding of complex directions and instructions.</li> <li>Show an understanding of common public announcements e.g. at an airport, at a stadium, etc.</li> </ul>	<ul style="list-style-type: none"> <li>Show an understanding of complex directions and instructions.</li> <li>Show an understanding of common public announcements e.g. at an airport, at a stadium, etc..</li> </ul>
8. Gain knowledge and understanding of target culture (s) through listening.	<ul style="list-style-type: none"> <li>Identify nationality/ background of speaker (s) of listening texts</li> <li>Demonstrate an understanding of the patterns of interactions from various English speaking cultures.</li> </ul>	<ul style="list-style-type: none"> <li>Demonstrate an understanding of the patterns of interactions from various English speaking cultures.</li> <li>Analyse the verbal and non-verbal social conventions that characterize the English speaking cultures.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Show an understanding of verbal and non- verbal social conventions that characterize the English speaking culture.</li> <li>▪ Compare and contrast the practices of both national and international cultures.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Show an understanding of verbal and non- verbal social conventions that characterize the English speaking culture.</li> <li>▪ Evaluate the practices and values of both national and international cultures.</li> </ul>
--	---	--

### 3.2 Speaking

Speaking constructs	Learning outcomes	
	Grade 11	Grade 12
1. Participate effectively in interactions and conversations.	<ul style="list-style-type: none"> <li>▪ Initiate, maintain and conclude an interaction using appropriate expressions.</li> <li>▪ Take part in conversations on subjects of common interest.</li> <li>▪ Speak fluently, accurately and effectively in different situations on a wide range of general or leisure topics.</li> <li>▪ Understand and respond to what has been said by the other interlocutors in conversation.</li> <li>▪ Ask questions for clarification and understanding.</li> <li>▪ Respond to questions.</li> <li>▪ Present ideas, opinions, experiences and arguments with confidence.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Initiate, maintain and conclude an interaction using both verbal and non-verbal expressions and with confidence.</li> <li>▪ Take part in relatively long conversation with multiple speakers on subjects of common interest.</li> <li>▪ Speak fluently, accurately and effectively according to social norms and cultural values in different situations on a wide range of general, academic, vocational or leisure topics.</li> <li>▪ Understand and respond to what has been said by the other interlocutors in conversation.</li> <li>▪ Ask questions for clarification and understanding.</li> <li>▪ Respond to questions in a convincing way.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Respect age, gender, social position of the listener.</li> <li>▪ Indicate understanding and express certainty or uncertainty.</li> <li>▪ Make proper use of extra linguistic features such as facial expressions and gestures.</li> <li>▪ Use common discourse markers.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Respect age, gender, social position and cultural traditions of the listener.</li> <li>▪ Present ideas, opinions, experiences and arguments with confidence.</li> <li>▪ Use discourse markers to enable others to follow what is being said.</li> <li>▪ Respond with suggestions, feedback and different viewpoints.</li> <li>▪ Change the topic of an interaction as required.</li> <li>▪ Indicate understanding and express certainty or uncertainty.</li> <li>▪ Negotiate meaning in communication.</li> <li>▪ Make proper use of extra linguistic features such as facial expressions and gestures.</li> <li>▪ Use a wide range of discourse markers.</li> </ul>
<p>2. Participate effectively in an informal discussion.</p>	<ul style="list-style-type: none"> <li>▪ Convey message effectively using appropriate language functions.</li> <li>▪ Comment and put forward point of a view clearly.</li> <li>▪ Give opinions on the topic of discussion.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Convey message effectively using appropriate language functions and idiomatic expressions.</li> <li>▪ Comment and put forward a point of view clearly and evaluate alternative proposals.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Comment on another person's opinions or viewpoints.</li> <li>▪ Express thoughts and ideas using verbal and non-verbal communication strategies.</li> <li>▪ Respect others' views and ideas.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Give opinions by providing relevant explanations, arguments and comments.</li> <li>▪ Comment on and judge another person's views and opinions with argument.</li> <li>▪ Be aware of social etiquette and apply in conversation.</li> <li>▪ Respect others' views and ideas.</li> </ul>
3. Participate effectively in a formal discussion.	<ul style="list-style-type: none"> <li>▪ Have a discussion on matters related to his/her field.</li> <li>▪ Ask and reformulate questions as required.</li> <li>▪ Present a point of view clearly.</li> <li>▪ Present and respond to arguments.</li> <li>▪ Take part in informal debates on the issues of current topics and concerns.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Have a discussion on matters related to his/her field.</li> <li>▪ Ask, reformulate and paraphrase questions as required.</li> <li>▪ Present a point of view clearly and in a convincing way.</li> <li>▪ Present and respond to arguments convincingly.</li> <li>▪ Take part in both formal and informal debates on the issues of current topics and concerns.</li> <li>▪ Make critical remarks or express disagreement.</li> </ul>
4. Give and take an interview.	<ul style="list-style-type: none"> <li>▪ Actively participate in an interview both as a interviewer and as an interviewee.</li> <li>▪ Expand the points being discussed.</li> <li>▪ Check and confirm information.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Actively participate in an interview, including group interview both as a interviewer and as an interviewee.</li> <li>▪ Expand the points being discussed in a persuasive way.</li> <li>▪ Check and confirm information.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Ask questions and respond to them properly.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ask questions and respond to them properly.</li> </ul>
5. Use telecommunications effectively.	<ul style="list-style-type: none"> <li>▪ Use telecommunications such as telephone, Skype and Viber effectively for personal purposes.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use telecommunications such as telephone, Skype and Viber effectively for personal and professional purposes.</li> <li>▪ Maintain appropriate etiquette and ethics of telecommunications.</li> </ul>
6. Narrate a sequence of events or process	<ul style="list-style-type: none"> <li>▪ Narrate a sequence of events or processes using appropriate structures and vocabulary.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Narrate a sequence of events or processes using appropriate structures and vocabulary.</li> </ul>
7. Use supra-segmental features like stress, tone and intonation for expressing a range of meanings and emotions.	<ul style="list-style-type: none"> <li>▪ Speak fluently and accurately with acceptable pronunciation, stress and intonation patterns.</li> <li>▪ Produce utterances with appropriate features of connected speech such as assimilation and elision.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Speak fluently and accurately with acceptable pronunciation, stress and intonation patterns.</li> <li>▪ Produce utterances with appropriate features of connected speech such as assimilation and elision.</li> </ul>
8. Make effective presentations.	<ul style="list-style-type: none"> <li>▪ Generate ideas and make presentations appropriate to the purpose and audience.</li> <li>▪ Choose appropriate expressions and registers according to the context/field.</li> <li>▪ Maintain appropriate posture and eye contact.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Generate ideas and make presentations appropriate to the purpose, audience, time and style.</li> <li>▪ Choose appropriate expressions and registers according to the context/field.</li> <li>▪ Use appropriate discourse markers.</li> <li>▪ Maintain appropriate posture and eye contact.</li> <li>▪ Use effective presentation skills.</li> </ul>

9. Describe, people, objects, events, etc.	<ul style="list-style-type: none"> <li>▪ Describe people, objects, events, etc. using appropriate structures and vocabulary.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe people, objects, events, etc. using appropriate structures and vocabulary.</li> </ul>
10. Seek and provide a wide variety of information.	<ul style="list-style-type: none"> <li>▪ Use a range of question forms for seeking and confirming required information.</li> <li>▪ Give detailed information on different topics.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use a range of expressions for seeking, confirming, checking and elaborating required information.</li> <li>▪ Give detailed information on different topics.</li> </ul>
11. Speak with critical analysis and evaluation.	<ul style="list-style-type: none"> <li>▪ Express personal opinions to clarify the points expressed.</li> <li>▪ Present reasons and examples from different sources such as reviews of books, plays and interviews to defend opinions and judgments.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Express personal opinions to clarify the points expressed and persuade the interlocutors.</li> <li>▪ Present reasons, examples and the details from different sources such as reviews of books, plays and interviews to defend opinions and judgments.</li> </ul>
12. Understand and demonstrate inter-cultural understanding.	<ul style="list-style-type: none"> <li>▪ Express one's own cultural values and practices effectively and clearly.</li> <li>▪ Express tolerance and respect for the cultural practices of other people.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Express one's own cultural values and practices and compare it with that of others.</li> <li>▪ Express tolerance and respect for the cultural practices of other people.</li> </ul>

*Note: The prescribed language functions should be included while selecting topics and tasks for speaking.*

### 3.3 Reading

Reading constructs	Learning outcomes	
	Grade 11	Grade 12
1. Read the texts intensively for information and understanding.	<ul style="list-style-type: none"> <li>▪ Scan the text and retrieve specific information from it.</li> <li>▪ Skim the text and get its main idea/theme.</li> <li>▪ Identify the topic sentence of a paragraph.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Scan the text and retrieve specific information from it.</li> <li>▪ Skim the text and get its main idea/theme.</li> <li>▪ Distinguish between cause and effect and fact and opinions.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Distinguish between cause and effect.</li> <li>▪ Separate facts from opinions.</li> <li>▪ Compare and contrast ideas.</li> <li>▪ Find out main ideas and supporting details.</li> <li>▪ Deduce the meanings of unfamiliar words and phrases in a given context.</li> <li>▪ Read the texts and identify the order of events.</li> <li>▪ Identify explicit as well as implicit information.</li> <li>▪ Read and interpret the graphic organizers (e.g. Venn diagram, time line, semantic webs, etc.) given in the text to facilitate understanding of grade appropriate reading texts.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compare and contrast ideas.</li> <li>▪ Identify different points of view.</li> <li>▪ Find out main ideas and supporting details.</li> <li>▪ Deduce the meanings of unfamiliar words and phrases in a given context.</li> <li>▪ Read the text and identify the order of events.</li> <li>▪ Identify explicit as well as implicit information.</li> <li>▪ Read and interpret the graphic organizers (e.g. Venn diagram, time line, semantic webs, etc.) given in the text to facilitate understanding of grade appropriate reading texts.</li> <li>▪ Follow the pattern of arguments with the help of the clues available in the text.</li> </ul>
2. Read a variety of literary texts for pleasure, appreciation and interpretation.	<ul style="list-style-type: none"> <li>▪ Read and interpret literary texts (e.g. short stories, essays, poems and dramas) from a wide variety of authors, subjects and genres.</li> <li>▪ Read and respond to literary works that represent a range of social, historical and cultural perspectives.</li> <li>▪ Interpret multiple levels of meaning such as literal</li> </ul>	<ul style="list-style-type: none"> <li>▪ Read and interpret literary texts (e.g. short stories, essays, poems and dramas) from a wide variety of authors, subjects and genres.</li> <li>▪ Read and respond to literary works that represent a range of social, historical and cultural perspectives.</li> <li>▪ Interpret multiple levels of meaning such as literal</li> </ul>

	<p>meaning, contextual meaning, figurative meaning and intended meaning in literary texts.</p> <ul style="list-style-type: none"> <li>▪ Analyse and evaluate fiction and non-fiction including the effect of diction and figurative language.</li> <li>▪ Analyse special features of languages that distinguish literary texts from non-literary ones.</li> <li>▪ Appreciate literary texts of appropriate level.</li> <li>▪ Determine the themes of literary texts.</li> <li>▪ Describe the characters of the literary texts.</li> </ul>	<p>meaning, contextual meaning, figurative meaning and intended meaning in literary texts.</p> <ul style="list-style-type: none"> <li>▪ Analyse and evaluate fiction and non-fiction including the effect of diction and figurative language.</li> <li>▪ Analyse special features of languages that distinguish literary texts from non-literary ones.</li> <li>▪ Appreciate literary texts of appropriate level.</li> <li>▪ Determine the themes of literary texts.</li> <li>▪ Describe the characters of the literary texts.</li> </ul>
<p>3. Read the texts and critically analyse, interpret and evaluate the information.</p>	<ul style="list-style-type: none"> <li>▪ Determine the writer's attitude, perspectives, purposes and intended meaning.</li> <li>▪ Identify the particular kind of language used in a particular text.</li> <li>▪ Analyse and synthesize information from different sources by making connections and showing relationships with other texts, ideas and subjects.</li> <li>▪ Form a variety of questions at different levels about the text.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Determine the writer's attitude, perspectives, purposes and intended meaning.</li> <li>▪ Identify the particular kind of language used in a particular text.</li> <li>▪ Analyse and synthesize information from different sources by making connections and showing relationships with other texts, ideas and subjects.</li> <li>▪ Form a variety of questions at different levels about the text.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Read, review and present a critical response to a text.</li> <li>▪ Express opinions and make judgments about ideas, information, experiences and issues presented in literary and factual texts.</li> <li>▪ Arrive at conclusion and comment on a given text.</li> <li>▪ Summarise the texts.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Read, review and present a critical response to a text.</li> <li>▪ Express opinions and make judgments about ideas, information, experiences and issues presented in literary and factual texts.</li> <li>▪ Arrive at conclusion and comment on a given text.</li> <li>▪ Summarise the texts.</li> </ul>
4. Read the texts closely and understand the structure and organization of the text.	<ul style="list-style-type: none"> <li>▪ Identify the structure and organization of paragraphs and longer texts by developing an awareness of cohesive devices.</li> <li>▪ Analyse the organisational patterns of a text (such as chronological, cause-effect, problem-solution and reason-conclusion).</li> <li>▪ Identify cohesive devices and their referents.</li> <li>▪ Identify the discourse markers and their functions in the texts.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify the structure and organization of paragraphs and longer texts by developing an awareness of cohesive devices.</li> <li>▪ Analyse the organisational patterns of a text (such as chronological, cause-effect, problem-solution and reason-conclusion).</li> <li>▪ Identify cohesive devices and their referents.</li> <li>▪ Identify the discourse markers and their functions in the texts.</li> <li>▪ Compare the structure of different types of text organization.</li> </ul>
5. Read the texts and predict the content and make inference.	<ul style="list-style-type: none"> <li>▪ Read the title and predict the content of the text.</li> <li>▪ Make predictions about the content of a text while reading based on contextual</li> </ul>	<ul style="list-style-type: none"> <li>▪ Read the title and predict the content of the text.</li> <li>▪ Make predictions about the content of a text while reading based on contextual clues,</li> </ul>

	<p>clues, text features, background knowledge, patterns of relationship of ideas, etc.</p> <ul style="list-style-type: none"> <li>▪ Make predictions about upcoming events in the narrative texts.</li> <li>▪ Make inferences from contextual information, writer's viewpoints, implied information, etc.</li> <li>▪ Use knowledge of the world or background knowledge while reading.</li> </ul>	<p>text features, background knowledge, patterns of relationship of ideas, etc.</p> <ul style="list-style-type: none"> <li>▪ Make predictions about upcoming events in the narrative texts.</li> <li>▪ Make inferences from contextual information, writer's viewpoints, implied information, etc.</li> <li>▪ Use knowledge of the world or background knowledge while reading.</li> </ul>
6. Read the texts and take notes.	<ul style="list-style-type: none"> <li>▪ Make notes by reading various resources.</li> <li>▪ Read a text and make notes covering the key points.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Make notes by reading various resources.</li> <li>▪ Read a text and make notes covering the key points.</li> <li>▪ Organise the notes and write on what has been read.</li> </ul>
7. Read and interpret the para-orthographic texts.	<ul style="list-style-type: none"> <li>▪ Interpret and integrate information presented in diagrammatic forms (charts, graphs, tables, maps etc.)</li> <li>▪ Paraphrase information or ideas of the texts.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Interpret and integrate information presented in diagrammatic forms (charts, graphs, tables, maps etc.)</li> <li>▪ Paraphrase information or ideas of the texts.</li> </ul>
8. Read texts and deduce the meaning of unfamiliar lexical items from the context.	<ul style="list-style-type: none"> <li>▪ Deduce the meaning of unfamiliar lexical items on the basis of contextual, syntactic and semantic clues.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Deduce the meaning of unfamiliar lexical items on the basis of contextual, syntactic and semantic clues.</li> </ul>

9. Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference material.	<ul style="list-style-type: none"> <li>▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials.</li> </ul>
10. Read and identify the practices and values of national and target cultures.	<ul style="list-style-type: none"> <li>▪ Read and identify the practices and values of national and target cultures.</li> <li>▪ Read a variety of texts from both national and international cultures for information and understanding.</li> <li>▪ Read and compare social, democratic, political and economic issues in both national and international cultures.</li> <li>▪ Read expository texts on issues affecting social, political, economic and cultural aspects in a given society.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Read and identify the practices and values of national and target cultures.</li> <li>▪ Read a variety of texts from both national and international cultures for information and understanding.</li> <li>▪ Read and compare social, democratic, political and economic issues in both national and international cultures.</li> <li>▪ Read expository texts on issues affecting social, political, economic and cultural aspects in a given society.</li> </ul>

### 3.4 Writing

Writing constructs	Learning outcomes	
	Grade 11	Grade 12
1. Compose well-formed paragraphs.	<ul style="list-style-type: none"> <li>▪ Compose well-formed paragraphs including the appropriate topic sentence, supporting details and a concluding sentence.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Compose well-formed paragraphs including the appropriate topic sentence, supporting details and a concluding sentence.</li> </ul>

<p>2. Write different kinds of letters and emails with appropriate format and layout.</p>	<ul style="list-style-type: none"> <li>▪ Write different types of personal letters such as letters to friends, and relatives.</li> <li>▪ Write emails.</li> <li>▪ Create blogs for expression.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write different types of formal letters such as letters to the editors, complain letters, job application letter, and business letters.</li> <li>▪ Write emails.</li> <li>▪ Prepare curriculum vitae (CV) with appropriate format and layout.</li> <li>▪ Create blogs for expression.</li> </ul>
<p>3. Write well organised essays on the given topics and the topics of own interest.</p>	<ul style="list-style-type: none"> <li>▪ Write well organised descriptive, narrative, argumentative and expository essays on the given topics and the topics of interest.</li> <li>▪ Edit the written products.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write well organised descriptive, narrative, argumentative and expository essays on the given topics and the topics of interest.</li> <li>▪ Edit the written products.</li> </ul>
<p>4. Write news articles on current issues.</p>	<ul style="list-style-type: none"> <li>▪ Write articles on current issues using appropriate forms and styles.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write articles on current issues using appropriate forms and styles.</li> </ul>
<p>5. Write formal reports in an appropriate style and format.</p>	<ul style="list-style-type: none"> <li>▪ Write study reports based on project works or mini-researches in an appropriate form and format.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write study reports based on project works or mini-researches in an appropriate form and format.</li> <li>▪ Narrate an event in a chronological order.</li> </ul>
<p>6. Narrate a sequence of events and personal experiences.</p>	<ul style="list-style-type: none"> <li>▪ Narrate an event in a chronological order.</li> <li>▪ Narrate a personal experience appropriately.</li> <li>▪ Write stories.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Narrate a personal experience appropriately.</li> <li>▪ Write biographies of famous national and international people.</li> <li>▪ Write a travelogue/memoire.</li> </ul>

7. Describe a person or event appropriately.	<ul style="list-style-type: none"> <li>▪ Describe a person or event using appropriate structures and vocabularies.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe a person or event using appropriate structures and vocabularies.</li> </ul>
8. Summarise a text.	<ul style="list-style-type: none"> <li>▪ Summarise a text into a short form condensing the information.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Summarise a text into a short form condensing the information.</li> </ul>
9. Write a character sketch.	<ul style="list-style-type: none"> <li>▪ Write a character sketch of the characters in a text.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write a character sketch of the characters in a text with sufficient arguments.</li> </ul>
10. Write a book/film review.	<ul style="list-style-type: none"> <li>▪ Write a critical review of a book/film.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write a critical review of a book/film.</li> </ul>
11. Transfer information from tables, graphs and charts to prose and vice versa.	<ul style="list-style-type: none"> <li>▪ Transfer information from tables, graphs and charts to prose and vice versa.</li> <li>▪ Describe and interpret tables, charts and graphs clearly.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Transfer information from tables, graphs and charts to prose and vice versa.</li> <li>▪ Describe and interpret tables, charts and graphs clearly.</li> </ul>
12. Prepare communiqué and press release.	<ul style="list-style-type: none"> <li>▪ Prepare communiqué in a simple and clear form.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Prepare a press release of an organisation.</li> </ul>
13. Use the mechanics of writing properly.	<ul style="list-style-type: none"> <li>▪ Write a variety of text types using spelling, punctuation, capitalisation, contractions, abbreviations, acronyms, numbers and numerals properly.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Write a variety of text types using spelling, punctuation, capitalisation, contractions, abbreviations, acronyms, numbers and numerals properly.</li> </ul>
14. Use various strategies for generating and organising ideas for writing.	<ul style="list-style-type: none"> <li>▪ Use writing strategies such as brainstorming, making mind maps and spider grams for generating ideas.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use writing strategies such as brain-storming, making mind maps and spider grams for generating ideas.</li> <li>▪ Gather required information for writing from various printed and online sources.</li> </ul>

	<ul style="list-style-type: none"> <li>▪ Gather required information for writing from various printed and online sources.</li> <li>▪ Draft interview questions to collect information.</li> <li>▪ Take notes while reading or interviewing and use the notes for writing.</li> <li>▪ Use a range of organisational strategies such as clustering, webbing, and mapping to present information.</li> <li>▪ Critically analyse the sample writings to find out their structure and styles.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Draft interview questions to collect information.</li> <li>▪ Take notes while reading or interviewing and use the notes for writing.</li> <li>▪ Use a range of organisational strategies such as clustering, webbing, and mapping to present information.</li> <li>▪ Critically analyse the sample writings to find out their structure and styles.</li> </ul>
15. Apply process approach to writing for producing a variety of creative writings.	<ul style="list-style-type: none"> <li>▪ Apply the stages of process approach (i.e. planning, making an outline, preparing the first draft and revising, editing and producing the final draft) for creating a variety of creative writings such as essays, personal experiences and articles.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Apply the stages of process approach (i.e. planning, making an outline, preparing the first draft and revising, editing and producing the final draft) to create a variety of creative writings such as essays, personal experiences and articles.</li> </ul>
16. Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference material.	<ul style="list-style-type: none"> <li>▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials for drafting, revising and editing their writing.</li> <li>▪ Develop personal dictionary.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Use an authentic English dictionary, thesaurus, encyclopedia, and academic reference materials for drafting, revising and editing their writing.</li> <li>▪ Develop personal dictionary.</li> </ul>

**Note:**

*Self-exploration and self-expression/creative writing should be dealt with as an inherent part while interacting with texts.*

## **4. Scope and Sequence**

### **4.1 Reading**

The content of reading section is divided into two parts: Part I and Part II. Part I includes a wide variety of contemporary issue-based thematic texts intended for the practice of (a) intensive reading (b) grammar (c) vocabulary (d) listening and speaking (e) writing. Part II is built on the successful exposition of Part I. Part II includes literary genre-based selected texts of different types for reading for pleasure, for both intensive and extensive purposes so as to enable the learners to discern different aspects of literary texts and practise creative writings, which involves expression of imagination.

#### **Part I (Outlines for the selection of texts)**

There will be a wide variety of texts on different issues- both local and global of mainly contemporary concerns, which include gender issues, diaspora, science and technology, depletion of natural resources, etc. There will be maximum 21 reading texts of moderate length not exceeding 2000 words and technical terms at each grade. The texts should be taken from various thematic areas that have been proposed below. Around each selected text, specially tailored exercises will be developed for supporting the learners' engagement with the texts.

<b>S.N.</b>	<b>Thematic areas</b>	<b>Possible topics</b>
1.	Education and humanity	ethics, human values, moral values, education, spirituality, animal rights, patriotism, responsibility of citizens
2.	Health, sports and adventure	yoga, travelogue, illness, disease, diet, nutrition, epidemics, hygiene, mental health, physical exercise, traditional and alternative medicine, meditation
3.	Media and society	change in communication and pace of life, advertising, bias in media, the Internet, radio and television, telephone, press
4.	History and culture	identity, language, ethnicity, ethnic groups in Nepal, folk literature, folk songs, folk culture/children's literature diaspora, ethics, cultural diversity, beliefs, values and norms, etiquette, historical events, national customs

5.	Ecology and development	global warming, deforestation, diversity, sustainable development, population, agronomy, forestry, wildlife, weather, ecosystem, food and water, the effect of man on nature, the environment, natural disaster
6.	Science and technology	ethics and science, impact of ICT on society, entertainment, renewable energy
7.	Globalisation and economy	international economy, migration, poverty and famine, global citizenship
8.	Humour and satire	humour, satire
9.	Democracy and human rights	democracy, human rights, gender, law and justice, legal awareness, children's rights, women's rights, rights of senior citizens, non-violence, charity
10.	Home life, family and social relationships	celebrations and social events, friendship, work, family, social acceptance, sex education
11.	Arts, music and creation	painting, arts, music, creation
12.	Fantasy	fantasy, imagination
13.	Career and entrepreneurship	jobs, career, entrepreneurship, problems of unemployment
14.	Power and politics	power, politics, struggle, conflict
15.	War and peace	war, peace
16.	Critical thinking	critical thinking, divergent thinking, logical thinking

### Possible text types for part I

A wide variety of texts will be covered for reading purposes. Reading texts for part I will cover the following types:

- interviews
- book/film reviews
- news reports and articles
- literary writings
- reports
- academic publications
- letters
- essays

- news articles
- biographies/auto-biographies
- product guides
- poems
- blogs
- brochures
- emails
- travelogues/memoire

**Part II (Outline for the selection of reading texts)**

As mentioned before, this part will consist of different types of creative works that involve the expression of imagination and art so that the students can perceive how language functions differently. These are higher functions. This section will expose the students to a different world of imagination and art. This will encourage them to read more, think more and express with individual artistry. There lies infinite possibility of growing independently. In this part, there will be maximum 20 reading texts of moderate length at each grade.

The genres that will be included in this part along with the number of texts of each genre is given below:

S. N.	Genres	Number of texts to be included
1.	Short stories	7
2.	Poems	5
3.	Essays	5
4.	One act plays	3
Total		20

Based on the above genres, different types of reading and writing tasks should be developed so that the students can think more independently, work creatively and develop a good foundation for the university level education.

The tasks incorporated in this part will focus on:

- glossary
- literary devices used in the texts
- comprehension questions (short and long: literature-based reading, reading between the lines, appreciation of texts, interpretation of texts)

- writing a summary
- describing the character
- comparing and contrasting
- critical and creative writing

## 4.2 Writing

Grade 11	Grade 12
1. Paragraphs	1. Paragraphs
2. Personal letters (letters to friends and relatives) emails, blogs	2. Formal letters (letters to the editors, job application, business letters)
3. Essays (descriptive, narrative, argumentative and expository)	3. Curriculum vitae
4. News articles	4. Essays (descriptive, narrative, argumentative and expository)
5. Formal reports based on project works or mini-research	5. News articles
6. Narratives (personal experiences, stories, events, travelogues, memoire)	6. Formal reports based on project works or mini-research
7. Descriptions (persons, events)	7. Narratives (personal experiences, stories, events, travelogues, memoire)
8. Summaries	8. Descriptions (persons, events)
9. Character sketch	9. Summaries
10. Book/film review	10. Character sketch
11. Transferring information from para-orthographic texts	11. Book/film review
12. Communique	12. Transferring information from para-orthographic texts
13. Mechanics of writing	13. Press release
14. Writing strategies	14. Mechanics of writing
15. Process approach to writing	15. Writing strategies
	16. Process approach to writing

## 4.3 Listening and speaking

As far as possible listening and speaking skills will be practised not in isolation but in the context of reading texts in an integrated way. Listening texts will cover the following types in both grades:

- Lectures
- Talks
- Presentations
- Conversations
- Personal accounts (e.g. oral anecdotes, past experiences, etc.)
- Interviews
- Short discussions
- Narratives (e.g. radio dramas)
- Procedures (e.g. instructions and directions)
- Factual accounts (news reports, eye witness accounts)
- Explanations (e.g. how an engine works)
- Expositions (debates, speech, advertisements)
- Public announcements
- Weather forecast

Speaking skill will be linked with the prescribed language functions. The prescribed language functions will be included in the tasks and topics for speaking. Speaking tasks and topics should be linked directly to the reading texts. Speaking tasks will cover the following main areas in both grades:

- conversations/interactions
- formal and informal discussions
- interviews
- telecommunications
- narrating
- making presentations
- describing

#### **4.4. Language functions**

The language functions prescribed in this curriculum should be the basis developing tasks for listening and speaking, and the grammar should be linked to the language functions.

Grade 11	Grade 12
1. Expressing good wishes 1. Giving directions and instructions 2. Expressing agreement/disagreement 3. Expressing decisions, intentions and plans 4. Expressing obligation 5. Requesting and offering 6. Suggesting and advising 7. Describing objects, people and places 8. Asking about opinions/giving opinions 9. Describing experiences 10. Describing hopes, wants and wishes	1. Expressing feelings, emotions and attitudes 2. Expressing certainty 3. Expressing indifference 4. Making comparisons and contrasts 5. Arguing/defending a point 6. Responding to counter arguments 7. Expressing disappointment 8. Clarifying 9. Describing processes 10. Predicting 11. Expressing degrees of certainty
11. Expressing certainty, probability, doubt 12. Interrupting 13. Generalizing and qualifying 14. Expressing reactions, e.g. indifference 15. Talking about regular actions and activities 16. Encouraging/discouraging 17. Persuading 18. Comparing past and present 19. Narrating past events, actions and experiences 20. Expressing complements 21. Reporting	12. Expressing necessity 13. Speculating 14. Giving reasons 15. Denying 16. Complaining/criticizing 17. Reminding 18. Summarizing 19. Narrating past events, actions and experiences 20. Reporting 21. Announcing

#### 4.5 Grammar

The grammar part of the curriculum will include the following topics:

- a. Adjectives and adverbs
- b. Concord/subject verb agreement

- c. Prepositions
- d. Modal auxiliaries
- e. Tense and aspects
- f. Infinitives and gerunds
- g. Conjunctions,
- h. Relative clause
- i. Voice
- j. Reported speech

The grammar should not be taught separately. It should be dealt with in the texts as far as possible.

#### **4.6. Sounds, vocabulary and dictionary use**

- a. Sound system of English
  - Consonants
  - Vowels
- b. Vocabulary study-word formation
 

<ul style="list-style-type: none"> <li>- Stem/root</li> <li>- Prefixes</li> <li>- Inflexion</li> <li>- Parts of speech</li> <li>- Nouns-number</li> <li>- Spelling</li> </ul>	<ul style="list-style-type: none"> <li>- Suffixes</li> <li>- Derivation</li> <li>- Synonyms/antonyms</li> <li>- Idioms and phrases</li> <li>- Verb conjugation</li> <li>- Punctuation</li> </ul>
---	--
- c. Dictionary use (focus on the use of electronic dictionary)
- d. Idioms and phrasal verbs

The Curriculum has two broad sections : Language Development and literature. The allocation of working hours for language development and literature will be 73 and 55 respectively.

*Note: Activities focusing on the specific features of vocabulary e.g. prefixes, suffixes, changing word class, synonyms, antonyms, giving single words, concussing words, etc. should be designed based on the reading texts.*

## 5. Learning Facilitation Process

### 5.1 Principles of Language Pedagogy

The current grade XI and XII curriculum is based on the following pedagogic principles :

- ***Content and language integrated learning:*** Language learning becomes effective when the learners develop an awareness of some specific content knowledge. Meaningful content relating to the real world helps learners comprehend not only the content itself but also the accompanying language. Integrating content and language is a clear departure from the mere communication towards a meaningful cognition through the language being learnt.
- ***Real world link:*** The principle of real world link is about exposing learners to the realities of the world through meaningful information and knowledge. Simulated and real tasks allow learners to envisage how the English language will be used in their real life.
- ***Diversity as a resource:*** In diverse classrooms, with learners from multilingual and multi-cultural backgrounds, exploiting diversity as a resource helps not only in the teaching learning process but also in creating social cohesion. The content from diverse contexts establishes the pluralistic concept first in the classrooms and later in the real world.
- ***Learning through Information and Communication Technology (ICT):*** With the advent of the ICT, language learning has been more accessible to the learners. The mobile and media technologies allow learners to access learning materials from anywhere and anytime. The use of ICT tools in the classroom pedagogy gives learners more autonomy in different ways.
- ***Learner engagement:*** Language learning becomes enriching as well as fulfilling when learners are fully engaged. Their engagement in the pedagogical process should be ensured with their involvement in the meaningful tasks, projects and out of class activities. Engaged learners are not only successful in developing their language but also become a resource for the class.

### 5.2 Learning Activities

Based on the above-mentioned pedagogical principles, the following activities have been suggested in order to achieve the competencies of this curriculum:

- Reading and presentation

- Writing projects
- Dramatization, role-play and simulation
- Inquiry-based writing
- Reading for comprehension
- Reading for critical assessment/analysis
- Discussion sessions
- Think - Pair- Share
- RDWS (Read, Discuss, Write and Say/Share)
- Teacher-guided self-study
- Journal writing
- Library visits
- Listening to lyrical poems and songs
- Reciting lyrical poems and songs
- Watching movies (animated/unanimated, comic) and dramas
- Brainstorming and mind mapping
- Quick write/flash writing
- Book/film reviews
- Paraphrasing

### **5.3 Instructional Materials for Learning Facilitation**

Each student must have a textbook. Each teacher should have a teacher's guide and a set of teacher support materials for the appropriate grade, including digital and electronic materials as far as practicable. Teachers should make an extensive and proper use of the board. To make learning easy, effective and interesting, a variety of materials should be used including the following:

- Charts
- Comparison tables
- Role cards
- Newspapers
- Bulletins, brochures
- Pictures/drawings

- Audio-visual materials
- Writing samples (e.g. essay, book/film review, mind mapping, brainstorming, etc.)
- Worksheets
- Flash cards
- Formats (of book review/film review/project work, etc.)
- Dictionaries, computers, audio players and mobile phones
- Multi-media
- Online resources
- Readers
- Additional references
- Sample interpretation/sample summaries/character sketches/poems, etc.

## 6. Student Assessment

The letter grading system will be used for assessing the students' performance. In order to assess the student's learning achievement as expected by this curriculum, formative as well as summative and internal as well as external assessment will be done.

In order to ensure the learning of the students, informal assessment will be conducted regularly and timely feedback will be provided to the students for improvement. The goal of formative assessment is to help the learners to learn more rather than to check what they have learnt and what they have not. Formative assessment should focus on those areas which pose problems in learning. This can also take the form of remedial teaching. Formative assessment should focus on the development of all the language skills and aspects in the learners. Various classroom activities and techniques should be used to help the learners to learn more. The following techniques/activities can be used as tools for formative assessment:

<ul style="list-style-type: none"> <li>• Observation of students' linguistic behaviour</li> <li>• Anecdotal record</li> <li>• Rating scale</li> <li>• Check lists</li> </ul>	<ul style="list-style-type: none"> <li>• Portfolio</li> <li>• Tests (class, weekly, monthly, trimister)</li> <li>• Project works</li> <li>• Creative works</li> </ul>	<ul style="list-style-type: none"> <li>• Games</li> <li>• Debates</li> <li>• Story telling/retelling</li> <li>• Poetry recitation</li> <li>• Dramatization/simulation</li> </ul>
--	---	--

<ul style="list-style-type: none"> <li>• Work sample/written samples</li> <li>• Interviews</li> <li>• Home assignments</li> </ul>	<ul style="list-style-type: none"> <li>• Self-initiation in learning</li> <li>• Class work</li> </ul>	<ul style="list-style-type: none"> <li>• Role play</li> <li>• Group discussion</li> <li>• Journal writing</li> </ul>
---	---	--

As a part of summative assessment, tests for assessing four skills of language, viz. listening, speaking, reading and writing will be conducted terminally. Listening and speaking tests will be conducted on practical basis. There will be both internal as well as external evaluation as part of summative or final assessment.

**6.1 Internal Evaluation:** The internal evaluation covers 25 marks. The allocation of marks is as follows:

S. N.	Areas	Marks
1.	Participation	3
2	Listening test	6
3	Speaking test	10
4	Score from terminal exams	6
	<b>Total marks</b>	<b>25</b>

**6.2 External evaluation:** The external evaluation carries 75 marks. The allocation of marks for each language skill and aspect is given below:

S. N.	Language skills and aspects	Marks
1.	Reading	35
2.	Writing	25
3.	Grammar	10
4.	Vocabulary	5
	<b>Total marks</b>	<b>75</b>

### 6.3 Alternative Evaluation

For the students with disabilities, alternative assessment tools will be used. They are suggested in the test specification grid.

### 6.4 Elaboration of Internal Assessment

Areas	Marks	Guidelines for evaluation
1. Participation	3	This covers students' attendance, participation in classroom activities and their performance on classwork, homework and project works assigned to them. The teacher needs to maintain the record of students.

		The same record is to be consulted to award the marks for this aspect.				
2. Listening test	6	<p><b>1. Listening comprehension</b></p> <p><b>Types of sound files:</b></p> <p>(The sound files may contain: lectures, talks, presentations, poetry, interviews, conversations, short discussions, advertisements, personal accounts (oral anecdotes, past experiences) narratives (e.g. radio dramas), instructions and directions, factual accounts (e.g. eye news reports, eye witness accounts) explanations, public announcements operating instructions, weather forecast)</p> <p>There will be two listening tasks on two different sound files. Each task should consist of three questions.</p> <p><i>Note: The sound files should be authentic and clearly articulated with normal speed of delivery. Each sound file should be of 3 minute maximum in length.</i></p> <p><b>Listening constructs to be focused:</b></p> <ol style="list-style-type: none"> <li>Specific information</li> <li>Gist</li> <li>Main information and supporting details</li> <li>Specific information and important details</li> </ol> <p><b>Number of sound files:</b> Two sound files each carrying 3 marks will be used.</p> <p><b>Length of the sound file:</b> Maximum three minutes</p> <p><b>Types of test items</b></p> <table border="1"> <tr> <td>1. Multiple choice</td> <td>3. Matching</td> </tr> <tr> <td>2. Fill in the blanks</td> <td>4. Short answer questions</td> </tr> </table> <p>Alternative test methods for students with speech and hearing difficulties</p> <p>For the students with speech and hearing difficulties, any one of the following types of questions can be asked:</p>	1. Multiple choice	3. Matching	2. Fill in the blanks	4. Short answer questions
1. Multiple choice	3. Matching					
2. Fill in the blanks	4. Short answer questions					

		<ol style="list-style-type: none"> <li>1. Paragraph writing on a given topic</li> <li>2. Writing a letter</li> <li>3. Writing a description of the given picture</li> </ol> <p>Time: 20 minutes.</p>
3. Speaking	10	<p><b>The speaking test will be administered practically. The test starts with greeting and introducing to make the students feel comfortable. This will not carry any marks. The speaking test consists of the following sections:</b></p> <p><b>1. Introduction and interview (3 marks)</b></p> <p>The students will be asked at least any three questions on their personal affairs and immediate situation. (How are you preparing for the exam? What will you study after grade 12? What's your aim in life? Do you like English? Why?/Why not?)</p> <p><b>2. Describing pictures (4 marks)</b></p> <p>The students are given a picture or a set of pictures. They are expected to describe the picture in at least 8 sentences.</p> <p><b>3. Speaking on a given topic (3marks)</b></p> <p>The students will be given a topic like; my school, my hobby, my family. They will get one-minute time to think over the topic and then they will speak on the topic. This will also be done individually.</p> <p><b>Time:</b> 10 to 15 minutes for per student</p> <p><b>Alternative test methods for students with visual difficulties</b></p> <p>For the students with visual difficulties, ask them to narrate a sequence of events instead of the task 2 'describing pictures' above.</p>
4. Score from terminal exams	6	3 marks from each terminal exams

# नेपाली

कक्षा : ११ र १२

विषय सङ्केत : Nep. 001 (कक्षा ११)

Nep. 002 (कक्षा १२)

पाठ्यघण्टा : ३

वार्षिक कार्यघण्टा : ९६

## १. परिचय

नेपाल बहुजातीय, बहुसांस्कृतिक एवम् बहुभाषिक मुलुक हो । बहुजातीय र बहुसांस्कृतिक विशेषता भएको राष्ट्रमा राष्ट्रिय एकता प्रवर्धन गर्न तथा सामाजिक, सांस्कृतिक सम्बन्ध र समन्वय कायम गर्न सम्पर्क भाषाको आवश्यकता पर्दछ । यसका लागि विद्यार्थीमा भाषिक सक्षमताको विकास हुनुपर्दछ । विद्यार्थीमा भाषिक सञ्चार एवम् बोध र अभिव्यक्तिगत सिपको विकास हुनु नै भाषिक सक्षमता हो । नेपाली भाषा विद्यालय तहको शिक्षणको प्रमुख माध्यम, सरकारी कामकाज र नेपाली समाजको साझा सम्पर्कको भाषा हो । पहिलो, दोस्रो एवम् विदेशी भाषाका रूपमा नेपाली भाषाको प्रयोग हुँदै आएको छ । यस दृष्टिले नेपाली भाषाको प्रयोगमा व्यापकता रहेको छ । नेपालमा नेपाली भाषा सामाजिकीकरण, अन्तरभाषिक व्यवहार, सञ्चार, प्रशासन, प्रविधि र मौखिक तथा लिखित व्यवहारको प्रमुख माध्यमका रूपमा रहिआएको छ । नेपाली समाजको बहुलतालाई दृष्टिगत गर्दै सबै प्रकारका ज्ञान र सिप प्राप्त गर्न तथा विभिन्न माध्यमबाट अन्तर्राष्ट्रिय स्तरका ज्ञानसमेत नेपाली भाषामा सिक्न सक्ने बनाउन विद्यालय तहमा नेपाली भाषाको शिक्षण अपरिहार्य छ । त्यसैले विद्यालय तहमा नेपाली भाषालाई अनिवार्य विषयका रूपमा शिक्षण गर्नुपरेको हो । नेपाली भाषा शिक्षणको मुख्य उद्देश्य विद्यार्थीमा नेपाली भाषासम्बद्ध भाषिक सिप एवम् व्यावहारिक र सिर्जनात्मक क्षमताको विकास गराउनु हो ।

प्रस्तुत पाठ्यक्रमको उद्देश्य विद्यार्थीमा भाषिक सक्षमता अभिवृद्धि गराउनु हो । (कक्षा ९-१०) पूरा गरेका विद्यार्थीको स्तरलाई ध्यान दिई विद्यालय तहको समाप्तिपछि अन्य क्षेत्रमा लाग्ने तथा उच्च शिक्षामा प्रवेश गर्नेहरूको आधारभूमिका रूपमा नेपाली भाषामा सक्षम बनाउने अभिप्रायले यो पाठ्यक्रम तयार पारिएको हो । माध्यमिक तह (कक्षा ११-१२) पूरा गर्दा विद्यार्थीहरूले नेपाली विषयमा प्राप्त गर्ने तहगत सक्षमता र कक्षागत सिकाइ उपलब्धिलाई यस पाठ्यक्रममा समावेश गरिएको छ । पाठ्यक्रममा विद्यार्थीमा बोध एवम् अभिव्यक्तिगत क्षमताको विकासका लागि उपयुक्त विधा र क्षेत्र निर्देश गरिएको छ । यसमा प्रयोजनपरक भाषिक सिप विकास र कार्यमूलक व्याकरणमा विशेष ध्यान दिइएको छ । तदनुरूपका सिकाइ सहजीकरण प्रक्रिया र मूल्याङ्कन विधि पनि समेटिएका छन् । यस पाठ्यक्रममा निम्नलिखित पक्षहरूलाई प्राथमिकतामा राखिएको छ :

- समयसापेक्ष जीवनोपयोगी एवम् सक्षमतामा आधारित भाषिक सिप
- पाठगत विविधताको प्रस्तुति र कार्यमूलक व्याकरण
- स्तरानुरूपका पाठ्यवस्तुको छनोट एवम् स्तरण
- विद्यार्थीकेन्द्रित सिकाइमा आधारित सहजीकरण प्रक्रिया
- प्रयोजनपरक भाषिक सिप र सिकाइमा जोड
- खोजपरक, परियोजनामूलक तथा सिर्जनात्मक भाषिक अभ्यासमा जोड
- भाषिक सामर्थ्य र सम्पादनका रूपमा भाषिक सिपको विकासमा जोड
- व्याकरणलाई भाषा प्रयोगको आधारका रूपमा सैद्धान्तिकभन्दा रचनात्मक बनाउने प्रयत्न
- स्वतन्त्र पठन र रचना कौशलको विकासमा जोड
- सिपगत सक्षमता परीक्षणमा आधारित भाषिक मूल्याङ्कन

## २. तहगत सक्षमता

यस तहका अन्त्यमा विद्यार्थीहरू निम्नलिखित सक्षमता प्राप्त गर्न समर्थ हुने छन् :

१. विविध विषयक्षेत्रका मौखिक सामग्रीको बोध र अभिव्यक्ति
२. विविध विषयक्षेत्रका लिखित सामग्रीको सुरुचिपूर्ण पठन र बोध
३. पाठगत सन्दर्भको अनुमान, घटना, चरित्र र परिवेशको पहिचान, बोध र प्रस्तुति
४. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुको मौखिक र लिखित अभिव्यक्ति
५. सामाजिक, सांस्कृतिक, राष्ट्रिय एवम् मानवीय मूल्यअनुकूलको लेख्य अभिव्यक्ति
६. दैनिक व्यावहारिक लेखनमा दक्षता प्रदर्शन
७. सिर्जनात्मक र प्रतिक्रियापरक अभिव्यक्ति कौशल
८. अन्तरसांस्कृतिक एवम् भाषिक मूल्यप्रतिको सचेतता र सम्मानजनक भाषिक व्यवहार
९. तार्किक, अन्तरक्रियात्मक एवम् समस्या समाधानमूलक अभिव्यक्ति कौशल
१०. खोज तथा परियोजनामा आधारित लेख र रचनाको सिर्जना
११. समालोचनात्मक चिन्तनसहितको मौखिक र लिखित अभिव्यक्ति

## ३. कक्षागत सिकाइ उपलब्धि

	कक्षा : एघार	कक्षा : बाह्र
१. सुनाइ र बोलाइ सिप	१. उच्चरित हुने वर्णहरूको पहिचान गरी शुद्ध उच्चारण गर्न	१. शब्द सुनी अक्षरीकरणसहित शुद्ध उच्चारण गर्न

	<p>२. विविध पाठ, सञ्चार माध्यम र अन्य सामग्री सुनेर तार्किक प्रतिक्रिया व्यक्त गर्न</p> <p>३. दिइएका विषय वा शीर्षकमा समूहगत छलफल एवम् प्रस्तुतीकरण गर्न</p> <p>४. सन्दर्भअनुसार गति, यति र लय मिलाई मौखिक अभिव्यक्ति गर्न</p> <p>५. देखेसुनेका, पढेका तथा अनुभव गरेका विषयलाई सिलसिला मिलाई प्रस्तुत गर्न</p> <p>६. सामाजिक, सांस्कृतिक सन्दर्भ, वक्ताको अवस्था तथा संवेगका आधारमा प्रतिक्रिया दिन</p>	<p>२. विविध पाठ, सञ्चार माध्यम र अन्य क्षेत्रका अभिव्यक्ति सुनेर विश्लेषणात्मक प्रतिक्रिया व्यक्त गर्न</p> <p>३. दिइएका विषय वा शीर्षकमा समूहगत छलफल एवम् प्रस्तुतीकरण गर्न</p> <p>४. सन्दर्भअनुसार गति, यति र लय मिलाई मौखिक प्रतिक्रिया व्यक्त गर्न</p> <p>५. देखेसुनेका तथा अनुभव गरेका विषयलाई सिलसिला मिलाई प्रस्तुत गर्न</p> <p>६. सामाजिक सन्दर्भ, प्रसङ्ग, वक्ताको अवस्था, अभिवृद्धि र संवेग तथा भाषाको प्रयोजनपरक भेदका आधारमा शिष्टतापूर्वक प्रतिक्रिया व्यक्त गर्न</p> <p>७. औपचारिक कार्यक्रममा सहभागी भई आफ्ना विचार प्रभावकारी रूपमा व्यक्त गर्न</p>
<p>२. पढाइ सिप</p>	<p>१. लिखित सामग्रीलाई गति, यति, लय मिलाई शुद्धसँग पढ्न</p> <p>२. साहित्यिक तथा प्रयोजनपरक पाठहरू पढी पारिभाषिक/प्राविधिक शब्दलाई वाक्यमा प्रयोग गर्न</p> <p>३. पाठमा प्रयोग भएका शब्दको हिज्जे र अर्थबोधका लागि शब्दको शको प्रयोग गर्न</p>	<p>१. लिखित सामग्रीलाई गति, यति, लय मिलाई शुद्धसँग पढ्न</p> <p>२. साहित्यिक तथा प्रयोजनपरक पाठहरू पढी पारिभाषिक/प्राविधिक शब्दको सन्दर्भअनुसार वाक्यमा प्रयोग गर्न</p> <p>३. पाठमा प्रयोग भएका शब्दको हिज्जे, उच्चारण, स्रोत, शब्दवर्ग, बनोट</p>

	<p>४. लिखित सामग्रीको सस्वर तथा मौन पठनद्वारा पढाइको गति विकास गर्न</p> <p>५. लिखित सामग्रीका आधारमा सन्दर्भको अनुमान, घटना, चरित्र र परिवेशको बोध गरी पढ्न</p> <p>६. विभिन्न पाठ तथा तिनका विशिष्ट अंशको व्याख्या एवम् समीक्षा गर्न सक्ने गरी पढ्न</p> <p>७. विविध क्षेत्रसँग सम्बन्धित पाठहरू पढी बोध गर्न</p> <p>८. पूर्वानुमान, निष्कर्ष, सारांश, संश्लेषण, प्रतिक्रिया व्यक्त गर्न सक्ने गरी पाठहरू पढ्न</p>	<p>र अर्थ पहिचानका लागि शब्दको शको प्रयोग गर्न</p> <p>४. लिखित सामग्रीको द्रुतपठन गर्न</p> <p>५. लिखित सामग्री भाव विश्लेषण गर्न सक्ने गरी पढ्न</p> <p>६. विभिन्न पाठ तथा तिनका विशिष्ट अंशको व्याख्या एवम् समीक्षा गर्न सक्ने गरी पढ्न</p> <p>७. विविध क्षेत्रसँग सम्बन्धित पाठहरू पढी बोध गर्न</p> <p>८. पूर्वानुमान, निष्कर्ष, सारांश, संश्लेषण, विश्लेषण, गरी प्रतिक्रिया व्यक्त गर्न सक्ने गरी पाठहरू पढ्न</p>
३. लेखाइ सिप	<p>१. नेपाली वर्णको पहिचान र वर्गीकरण गरी लेख्न</p> <p>२. वर्णविन्यास र लेख्य चिह्नहरूको शुद्ध प्रयोग गर्न</p> <p>३. मौखिक एवम् लिखित अभिव्यक्तिको बुँदाटिपोट गर्न र सारांश लेख्न</p> <p>४. व्यावहारिक लेखन (घरायसी पत्र, निमन्त्रणा, बधाई, शुभकामना, सम्मानपत्र, सूचना, विज्ञापन, श्रद्धाञ्जली, समवेदना) गर्न</p> <p>५. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुका वारेमा सिलसिला मिलाएर लिखित वर्णन गर्न</p>	<p>१. शब्दमा रहेका अक्षर संरचना छुट्टयाई लेख्न</p> <p>२. वर्णविन्यास र लेख्य चिह्नहरूको शुद्ध प्रयोग गर्न</p> <p>३. विज्ञान, प्रविधि, सामाजिक शास्त्र, वाणिज्य कानून आदि क्षेत्रसँग सम्बन्धित प्रयोजनपरक लेखन गर्न</p> <p>४. व्यावहारिक लेखन गर्न (व्यावसायिक पत्र, भरपाई, तमसुक, करारनामा, मन्जुरीनामा, मुचुल्का, प्रशासनिक टिप्पणी तथा बैठक निर्णय, विज्ञप्ति, बोलपत्र र सम्पादकलाई चिठी लेखन)</p>

	<p>६. कुनै पनि विषय शीर्षकमा अर्थपूर्ण, क्रमबद्ध तथा प्रभावकारी रूपमा अनुच्छेद रचना गर्न</p> <p>७. पाठको प्रकृतिअनुसार विषयक्षेत्र, संरचना (आदि, मध्य र अन्त्यको शृङ्खला), घटना, चरित्र, परिवेश, भाव, लयबोध गरी लेख्न</p> <p>८. साहित्यिक विधा र पाठहरूको विश्लेषण गर्न र विशिष्ट अंशको व्याख्या गर्न</p> <p>९. लिखित अभिव्यक्तिका क्रममा व्याकरणका आधारभूत नियम पालना गरी लेख्न</p> <p>१०. विभिन्न विधामा आधारित भई निर्देशित र स्वतन्त्र सिर्जना गर्न</p> <p>११. कोशीय प्रविष्टिअनुसार शब्दक्रम मिलाई लेख्न</p>	<p>५. सामाजिक, सांस्कृतिक, राष्ट्रिय एवम् मानवीय मूल्यमा आधारित भई लिखित अभिव्यक्ति दिन</p> <p>६. देखेसुनेका, पढेका र अनुभव गरेका विषयवस्तुका बारेमा सिलसिला मिलाएर लिखित वर्णन गर्न</p> <p>७. पाठको प्रकृतिअनुसार सन्दर्भको अनुमान, संरचना पहिचान, घटना वर्णन, भावबोध, तार्किक विश्लेषण गरी लेख्न</p> <p>८. साहित्यिक विधा र पाठहरूको विश्लेषण गर्न र विशिष्ट अंशको व्याख्या गर्न</p> <p>९. लिखित अभिव्यक्तिका क्रममा व्याकरणका आधारभूत नियम पालना गरी लेख्न</p> <p>१०. विभिन्न विधामा आधारित भई निर्देशित र स्वतन्त्र सिर्जना गर्न</p> <p>११. विद्युतीय सञ्चार माध्यममा प्रकाशित सामग्री तथा पुस्तक र लेख रचना पढी प्रतिबिम्बात्मक लेखन गर्न</p> <p>१२. कोशीय प्रविष्टिअनुसार शब्दक्रम मिलाई लेख्न</p>
--	---	--

#### ४. विषयवस्तुको क्षेत्र र क्रम

(क) कक्षा : ११

क्र.स.	विधा/पाठ	क्षेत्र	बोध	अभिव्यक्ति	भाषातत्त्व	पाठ्य घण्टा
१.	कविता (पद्य)	देशभक्ति	<ul style="list-style-type: none"> <li>● कविताको संरचना</li> <li>● विषयको क्रम, भाषा, लय आदिको बोध</li> <li>● देशभक्ति, संस्कृति र भाषासम्बन्धी पद्यांशको बोध</li> </ul>	<ul style="list-style-type: none"> <li>● कविताको लयबद्ध वाचन</li> <li>● कवितालाई गद्यमा रूपान्तरण</li> <li>● कविता सिर्जना (अनुकरणात्मक लेखन)</li> </ul>	(अ) नेपाली कथ्य र लेख्य वर्ण (स्वर र व्यञ्जन) को पहिचान (आ) उच्चार्य व्यञ्जन वर्णको पहिचान र प्रयोग (स्थान, प्रयत्न, घोषत्व र प्राणत्व)	७
२.	कथा	सामाजिक	<ul style="list-style-type: none"> <li>● कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● कथाका घटनाहरूको टिपोट</li> <li>● कथाका पात्रहरूको चरित्र वर्णन</li> <li>● लघुकथा लेखन (अनुकरणात्मक)</li> </ul>	(अ) मूल र व्युत्पन्न शब्दको पहिचान (आ) शब्द स्रोत : तत्सम, तद्भव र आगन्तुक शब्द (इ) शब्दकोशीय प्रयोग	८
३.	निबन्ध	सांस्कृतिक (आत्मपरक)	<ul style="list-style-type: none"> <li>● निबन्धको संरचना (अनुच्छेद योजना, विषय प्रस्तुतिको क्रम, भाषाशैली आदि) को बोध</li> <li>● निबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध</li> </ul>	<ul style="list-style-type: none"> <li>● निबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट र सार लेखन</li> <li>● स्थानीय समाजमा प्रचलित चाडपर्वको वर्णन गरी निबन्ध लेखन</li> </ul>	(अ) पदवर्ग (नाम, सर्वनाम, विशेषण र क्रियापद) को प्रयोगात्मक पहिचान	७

				<ul style="list-style-type: none"> <li>● तार्किक, अन्तरक्रियात्मक एवम् समस्या समाधानमूलक लेखन</li> </ul>		
४.	जीवनी	(राष्ट्रिय)	<ul style="list-style-type: none"> <li>● जीवनीको संरचना (जीवन विषयक घटना शृङ्खला, अनुच्छेद योजना, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● जीवनीमा प्रस्तुत घटनाक्रमको वर्णन</li> <li>● आफ्नो समाजमा प्रतिष्ठित कुनै व्यक्तिको जीवनी लेखन</li> <li>● जीवनीबाट प्राप्त सन्देश/ शिक्षाको अभिव्यक्ति</li> </ul>	(अ) पदवर्ग (नामयोगी, क्रियायोगी, संयोजक, विस्मयादिबोधक र निपात) को प्रयोगात्मक पहिचान (आ) शब्द रूपायन	७
५.	पत्र लेखन	घरायसी	<ul style="list-style-type: none"> <li>● पत्र लेखनको संरचना (विषय, प्रस्तुतिक्रम, ढाँचा, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● पत्र लेखनमा प्रस्तुत विषयवस्तु र ढाँचाको टिपोट</li> <li>● विषयको प्रस्तुति</li> <li>● निर्दिष्ट विषयमा पत्र लेखन</li> <li>● निमन्त्रणा, बधाई, शुभकामना, अभिनन्दनपत्र, सम्मानपत्र, सूचना, विज्ञापन, श्रद्धाञ्जली, समवेदनाको ढाँचा र शैलीको अध्ययन तथा लेखन अभ्यास</li> </ul>	लेख्य चिह्न र तिनको प्रयोग (पूर्णविराम, अर्धविराम, अल्पविराम, कोष्ठक, विकल्पबोधक/तिर्यक्, प्रश्नवाचक, उद्धरण, विस्मयसूचक/उद्गार, निर्देशक, योजक, छुट चिह्न/कागपादे चिह्न,	८

६.	कथा	मनोवैज्ञानिक	<ul style="list-style-type: none"> <li>● कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● कथाका घटनाहरूको टिपोट</li> <li>● कथाका पात्रहरूको चरित्र वर्णन</li> <li>● पढेका नयाँ कथाका बारेमा प्रस्तुति</li> <li>● लघुकथा लेखन (अनुकरणात्मक)</li> </ul>	(अ) वर्णविन्यासको पहिचान र प्रयोग (आ) भाषिक प्रयोगमा पदयोग र पदवियोगको पहिचान र प्रयोग	८
७.	निबन्ध	प्राकृतिक (वस्तुपरक)	<ul style="list-style-type: none"> <li>● निबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध</li> <li>● निबन्धको शैली र ढाँचाको अध्ययन</li> </ul>	<ul style="list-style-type: none"> <li>● निबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट, सारांश</li> <li>● प्रकृति तथा वातावरणको वर्णन गरी निबन्ध लेखन</li> <li>● खोज तथा परियोजनामा आधारित भई समालोचनात्मक चिन्तन सहितको लेखन</li> </ul>	उपसर्गद्वारा शब्दनिर्माण (अ) अ, अन, कु, बि, बे, बद, गैर, ना (आ) अति, अधि, अनु, अप, अभि, अव, आ, उत्, उप, दुर, दुस्, नि, निर, निस, परा, परि, प्र, प्रति, वि, सम्, सु	७
८.	लघुनाटक	सामाजि/ मनोवैज्ञानिक	<ul style="list-style-type: none"> <li>● नाटकको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, मञ्चीयता, चरित्र, संवाद, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● नाटकका प्रमुख पात्रको चरित्र वर्णन</li> <li>● नाटकका घटना तथा परिवेशको वर्णन</li> <li>● नाटकको संवादात्मक अभिनय (विषयको प्रस्तुति, हाउभाउ)</li> </ul>	प्रत्ययद्वारा शब्द निर्माण: (क) अक्कड, अत, अन्त, आइ, आई/याई, आउ, आली, आलु, आवट, आहा/याहा, इया,	११

				<ul style="list-style-type: none"> <li>● संवाद लेखन</li> <li>● प्रतिवेदन लेखन (कार्यक्रम, भ्रमण, घटना)</li> </ul>	(ख) इयार, इलो, ई, उवा, ए, एली, ओ, ओट, औ ली/यौली, पन/पना, ली, ले	
९	रिपोर्ताज मूलक रचना	स्वास्थ्य, योग तथा चिकित्सा	<ul style="list-style-type: none"> <li>● रिपोर्ताजको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध</li> <li>● रिपोर्ताजमा प्रयुक्त कठिन शब्दको अर्थबोध</li> <li>● रिपोर्ताजको ढाँचा र शैलीको अध्ययन</li> </ul>	<ul style="list-style-type: none"> <li>● रिपोर्ताजमा वर्णित मुख्य विषयको बुँदाटिपोट, टिप्पणी लेखन</li> <li>● स्वास्थ्य, योग र चिकित्साको वर्णन गरी रिपोर्ताज लेखन</li> <li>● रिपोर्ताजमा प्रयुक्त कठिन शब्दबाट वाक्य रचना</li> <li>● प्रतिवेदन लेखन ढाँचा र शैलीको अध्ययन र लेखन अभ्यास</li> </ul>	प्रत्ययद्वारा शब्द निर्माण: अक, अन, अनीय, इक, इत, ई, ईन/ईण, ईय, क, तर, तम, तव्य, ता, ति, त्व, मय, मान्, वान्, य	८
१०.	संवादात्मक रचना	कृषि, वन तथा वातावरण	<ul style="list-style-type: none"> <li>● संवादको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● संवादमा प्रस्तुत विषयवस्तुको टिपोट</li> <li>● विषयको प्रस्तुति, हाउभाउ</li> <li>● निर्दिष्ट विषयमा संवाद लेखन तथा मौखिक अभिव्यक्ति र अभिनय</li> <li>● उद्घोषण, समाचार वाचन, प्रवचन आदिको अभ्यास</li> </ul>	समास प्रक्रियाद्वारा शब्द निर्माण (अव्ययीभाव, कर्मधारय, तत्पुरुष, द्वन्द्व, द्विगु, बहुव्रीहि (समास र विग्रहसमेत)	८

११.	दैनिकी रचना	पर्यटन	<ul style="list-style-type: none"> <li>निर्दिष्ट पाठको बोध (अनुमान, संरचना पहिचान आदि)</li> <li>निर्दिष्ट पाठमा प्रयुक्त प्राविधिक तथा पारिभाषिक शब्दको अर्थबोध</li> </ul>	<ul style="list-style-type: none"> <li>निर्दिष्ट पाठसँग सम्बन्धित रचना</li> <li>बुँदाटिपोट र सारांश लेखन</li> <li>दैनिकी लेखन</li> <li>अनुकरणात्मक लेखन</li> </ul>	<p>(अ) द्वित्व प्रक्रियाद्वारा शब्द निर्माण (पूर्ण, आंशिक र अपरिवर्तित द्वित्व)</p> <p>(आ) सन्धि र सन्धि भएका शब्दको पहिचान</p>	८
१२.	वक्तृ-तात्मक रचना	जलस्रोत र ऊर्जा	<ul style="list-style-type: none"> <li>वक्तृताको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>वक्तृतामा प्रस्तुत विषयवस्तुको टिपोट</li> <li>हाउभाउसहित विषयको प्रस्तुति</li> <li>निर्दिष्ट विषयमा वक्तृता लेखन तथा मौखिक अभिव्यक्ति र अभिनय</li> </ul>	<p>(अ) उद्देश्य र उद्देश्य विस्तार तथा विधेय र विधेय विस्तार, पहिचान र प्रयोग</p> <p>(आ) व्याकरणात्मक कोटिका आधारमा वाक्य परिवर्तन (लिङ्ग, वचन, पुरुष, आदर)</p>	
				<ul style="list-style-type: none"> <li>उद्घोषण, समाचार वाचन, प्रवचन आदिको अभ्यास</li> <li>वक्तृता/ वादविवाद आयोजना</li> <li>विभिन्न ढाँचामा प्रतिवेदन लेखन</li> </ul>	<p>(इ) कथन (प्रत्यक्ष, अप्रत्यक्ष)</p> <p>(ई) ध्रुवीयता (करण, अकरण)</p>	९
जम्मा						९६

(ख) कक्षा : १२

क्र.स.	पाठ	क्षेत्र	बोध	अभिव्यक्ति	भाषातत्त्व	पाठ्य घण्टा
१.	कविता (गद्य कविता)	सामाजिक	<ul style="list-style-type: none"> <li>● कविताको संरचना (विषयको क्रम, भाषा, शैलीको बोध आदि) षा</li> <li>● गद्य कविताको लयबोध</li> </ul>	<ul style="list-style-type: none"> <li>● कवितालाई अनुच्छेदमा रूपान्तर</li> <li>● कविताको लयबद्ध वाचन</li> <li>● कविता सिर्जनाको अभ्यास</li> </ul>	नेपाली अक्षरको पहिचान र उच्चारण अभ्यास	७
२.	कथा	ऐतिहासिक/ पौराणिक/ सांस्कृतिक	<ul style="list-style-type: none"> <li>● कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● कथामा प्रयुक्त घटनाहरूको सिलसिलाबद्ध टिपोट</li> <li>● निर्देशित वा स्वतन्त्र कथा लेखन अभ्यास</li> <li>● विद्युतीय तथा सञ्चार माध्यममा प्रकाशित कथाहरूको अध्ययन र प्रभावको प्रस्तुति</li> </ul>	पदवर्ग (नाम, सर्वनाम, विशेषण र अव्यय) को पहिचान र प्रयोग	७
३.	निबन्ध	नियात्रा	<ul style="list-style-type: none"> <li>● निबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध</li> <li>● निबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध</li> </ul>	<ul style="list-style-type: none"> <li>● आफूले गरेको कुनै यात्राको वर्णन</li> <li>● निबन्ध लेखन</li> <li>● विद्युतीय सञ्चार माध्यम र प्रकाशित उपयोगी लेख रचनाहरूको अध्ययन र त्यसबाट प्राप्त विषयवस्तु, सन्देश आदिको प्रस्तुति</li> </ul>	(अ) पदसङ्गति (क) लिङ्ग (ख) वचन (ग) पुरुष (घ) आदर (सामान्य, मध्यम, उच्च) (आ) शब्द रूपायन	७

				<ul style="list-style-type: none"> <li>● तार्किक, अन्तरक्रियात्मक एवम् समस्या समाधानमूलक लेखन</li> </ul>		
४.	पत्र लेखन (व्यावसयिक)		<ul style="list-style-type: none"> <li>● पत्र लेखनको संरचना (विषय, प्रस्तुतिक्रम, ढाँचा, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>● पत्र लेखनमा प्रस्तुत विषयवस्तुको टिपोट</li> <li>● विषयको प्रस्तुति</li> <li>● निर्दिष्ट विषयमा पत्र लेखन</li> <li>● भरपाई, तमसुक, करारनामा, मञ्जुरीनामा, मुचुल्का, प्रशासनिक टिप्पणी, बैठक निर्णय, विज्ञापन, सूचना, विज्ञप्ति, बोलपत्र, सम्पादकलाई चिठीको ढाँचा र शैलीको अध्ययन र लेखन अभ्यास</li> <li>● विद्युतीय सञ्चार माध्यममा उपलब्ध प्रयोजनपरक सामग्रीको अध्ययन र लेखन अभ्यास</li> </ul>	वाक्यको पहिचान र प्रयोग (क) सरल, संयुक्त र मिश्र वाक्यको पहिचान र प्रयोग (ख) निर्धारित कथाबाट सरल, मिश्र र संयुक्त वाक्यको पहिचान र वाक्यान्तरण	६
५.	उपन्यासको अंश	सामाजिक	<ul style="list-style-type: none"> <li>● उपन्यास अंशको संरचना (विषय, परिच्छेद योजना, घटना शृङ्खला, पात्र, संवाद, भाषाशैली आदि) को बोध</li> <li>● शब्दभण्डारको बोध</li> </ul>	<ul style="list-style-type: none"> <li>● उपन्यास अंशको विषयवस्तु वर्णन</li> <li>● उपन्यासको अंशका प्रमुख पात्रको चरित्र वर्णन</li> <li>● उपन्यासको अंशको घटना तथा परिवेशको वर्णन</li> <li>● आफूले अध्ययन गरेको कुनै एक</li> </ul>	क्रियाका काल (भूत, अभूत) पक्ष : अपूर्ण, पूर्ण, अज्ञात, अभ्यस्त (आ) नेपाली वर्णविन्यासको	१४

				उपन्यासको विषयवस्तु, पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति	प्रयोगात्मक अभ्यास	
६.	जीवनी	अन्तर्राष्ट्रिय	<ul style="list-style-type: none"> <li>जीवनीको संरचना (जीवन विषयक घटना शृङ्खला, अनुच्छेद योजना, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>जीवनीमा प्रस्तुत घटनाक्रमको वर्णन</li> <li>आफ्नो समाजमा प्रतिष्ठित कुनै व्यक्तिको जीवनी लेखन</li> <li>खोज तथा परियोजनामा आधारित भई समालोचनात्मक चिन्तनसहितको लेखन</li> </ul>	क्रियाका भाव : सामान्य, आज्ञा, इच्छा, सम्भावना, सङ्केत	७
७.	गीति कविता	सामाजिक / सांस्कृतिक	<ul style="list-style-type: none"> <li>कविताको संरचना (विषयको क्रम, भाषा, लय आदि) को बोध</li> <li>पद्य र गद्य कविताको लयबोध</li> <li>गजलको संरचना बोध</li> </ul>	<ul style="list-style-type: none"> <li>कविताको लयबद्ध वाचन</li> <li>गीति कविता सिर्जना</li> <li>विद्युतीय सञ्चारमा उपलब्ध मुक्तक तथा कवितात्मक सामग्रीको अध्ययन र कक्षामा प्रस्तुति</li> <li>गजलको रचना</li> </ul>	उपसर्ग र प्रत्ययद्वारा शब्द निर्माणसम्बन्धी अभ्यास	७
८.	कथा	समाज मनोवैज्ञानिक	<ul style="list-style-type: none"> <li>कथाको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>कथामा वर्णित घटनाको सिलसिलाबद्ध टिपोट</li> <li>कथाका पात्रहरूको चरित्र वर्णन</li> <li>कथा सिर्जनाको अभ्यास</li> <li>आफूले अध्ययन गरेको कम्तीमा कुनै एक उपन्यासको विषयवस्तु,</li> </ul>	द्वित्व र समास प्रक्रियाद्वारा शब्द निर्माणसम्बन्धी अभ्यास	७

				पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति		
९.	आख्यानमात्मक रचना	सञ्चार, विज्ञान तथा प्रविधि	<ul style="list-style-type: none"> <li>आख्यानको संरचना (विषय, अनुच्छेद योजना, घटनाक्रम, संवाद, भाषा आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>आख्यानमा वर्णित घटनाको सिलसिलाबद्ध टिपोट</li> <li>आख्यानका पात्रहरूको चरित्र वर्णन</li> <li>कथा सिर्जनाको अभ्यास</li> <li>आफूले अध्ययन गरेको कुनै एक आख्यानको विषयवस्तु, पात्र, परिवेश, सन्देश आदि बारेमा मौखिक तथा लिखित अभिव्यक्ति</li> </ul>	कारक र विभक्तिको पहिचान र प्रयोग (अ) कारकका सरल र तिर्यक् रूप (आ) कारकका प्रकार : कर्ता, कर्म, करण, सम्प्रदान, अपादान, अधिकरण (इ) विभक्तिको प्रयोग	५
१०.	संवादात्मक रचना	समाज, संस्कृति र शिक्षा	<ul style="list-style-type: none"> <li>संवादको संरचना (विषय, प्रस्तुतिक्रम, हाउभाउ, तर्क, संवाद, भाषाशैली आदि) को बोध</li> </ul>	<ul style="list-style-type: none"> <li>संवादमा प्रस्तुत विषयवस्तुको टिपोट</li> <li>हाउभाउसहित विषयको प्रस्तुति</li> <li>निर्दिष्ट विषयमा संवाद लेखन तथा मौखिक अभिव्यक्ति र अभिनय</li> <li>शिक्षा र सांस्कृतिक शीर्षकमा वक्तव्य, समाचार वाचन, प्रवचन आदिको अभ्यास</li> </ul>	(क) वाक्य संश्लेषण र विश्लेषण (ख) वाच्य (कर्तृ, कर्म, भाव) को पहिचान र प्रयोग	५

११.	प्रबन्धात्मक रचना	कानून, प्रशासन र व्यवस्थापन	<ul style="list-style-type: none"> <li>● प्रबन्धको संरचना (विषय प्रस्तुतिको क्रम, अनुच्छेद योजना, भाषाशैली आदि) को बोध</li> <li>● प्रबन्धमा प्रयुक्त कठिन शब्दको अर्थबोध</li> </ul>	<ul style="list-style-type: none"> <li>● प्रबन्धमा वर्णित मुख्य विषयको बुँदाटिपोट, सारांश</li> <li>● प्रकृति तथा वातावरणको वर्णन गरी प्रबन्ध लेखन</li> <li>● प्रबन्धमा प्रयुक्त कठिन शब्दबाट वाक्य रचना</li> <li>● बैठक (माइन्चुट) को उपस्थिति तथा निर्णय एवम् भरपाई, मुचुल्का र प्रशासनिक टिप्पणीको नमुना लेखन</li> <li>● व्यक्तिगत विवरण (बायोडाटा) लेखन</li> </ul>	(अ) पदक्रम (क) सामान्य पदक्रम (ख) विशिष्ट पदक्रम (आ) लेख्य चिह्न र तिनको प्रयोग	६
१२.	रिपोर्ताज-मूलक रचना	अर्थ, उद्योग र वाणिज्य	<ul style="list-style-type: none"> <li>● रिपोर्ताज पाठको बोध (अनुमान, संरचना पहिचान आदि)</li> <li>● रिपोर्ताज पाठमा प्रयुक्त प्राविधिक तथा पारिभाषिक शब्दको अर्थबोध</li> <li>● विभिन्न पत्रिकामा प्रकाशित रिपोर्ताजको अध्ययन र प्रस्तुति</li> </ul>	<ul style="list-style-type: none"> <li>● निर्दिष्ट पाठसँग सम्बन्धित रचना</li> <li>● बुँदाटिपोट र सारांश लेखन</li> <li>● निर्दिष्ट अनुच्छेदको उत्तर लेखन</li> <li>● अनुकरणात्मक लेखन</li> <li>● विद्युतीय सञ्चार माध्यममा आधारित विविध लेखन अभ्यास</li> </ul>	(अ) उक्ति परिवर्तन (आ) उद्देश्य र विधेय विस्तार (इ) शब्दकोशीय प्रयोग	६
जम्मा						१६

## द्रष्टव्य :

- (क) विधाको माध्यमबाट विद्यार्थीले बोध, अभिव्यक्ति र भाषातः अवन्तर्गतका विषयवस्तुको सिकाइ गरी भाषिक सिपहरू र भाषिक कार्यहरूमा आवश्यक सक्षमताको विकास गर्नेछन् ।
- (ख) रिपोर्टाजमूलक रचना भनेको कुनै पनि विषयमा गरिएको खोजमूलक र आख्यानतात्मक संरचना भएको तथ्यमा आधारित समसामयिक प्रचलित लेखन हो ।
- (ग) पाठ्यपुस्तक विकास गर्दा प्रयोजनपरक रचनाहरूलाई साहित्यिक विधासँग सम्बन्धित पाठहरूको विचमा आवश्यकतानुसार क्रम मिलाएर राख्नुपर्ने छ ।
- (घ) विधाको क्षेत्र तथा क्रम र विस्तृतीकरणमा उल्लेख भएका पाठहरूमा प्रयोग भएका आधारमा उपयुक्तताअनुसार शब्दभण्डारको अभ्यास गराउनुपर्ने हुन्छ । यसका लागि पर्यायवाची शब्द, विपरीतार्थी शब्द, अनुकरणात्मक शब्द, अनेकार्थी शब्द, श्रुतिसमभिन्नार्थक शब्द, सङ्क्षिप्त शब्द, उखान टुक्का, लघुतावाची शब्द, सिङ्गो शब्द, समूहवाचक शब्द, पारिभाषिक/ प्राविधिक जस्ता शब्दहरूको अर्थ र सन्दर्भपूर्ण प्रयोगको अभ्यास गराउनु अपेक्षित छ । पाठमा प्रयुक्त भएका शब्दहरूलाई केन्द्रबिन्दु मानी विभिन्न का शब्दभण्डारको विकास गराउने दृष्टिकोण यसमा राखिएको छ । शब्दका विभिन्न अर्थ सम्बन्धहरू र गत विविधतालाई ख्याल राखी शब्दहरूको अर्थ र सन्दर्भपूर्ण प्रयोगमा जोड दिइने छ । यस क्रममा प्रयुक्त र तत्सम्बन्धी उखान टुक्काहरूको प्रयोगलाई पनि समावेश गरिने छ ।
- (ङ) यस पाठ्यक्रम कार्यान्वयन र शिक्षण सिकाइका क्रममा सिर्जनात्मक सोचाइ/चिन्तन, समस्या समाधान, विद्युतीय सञ्चार सिप, सहकार्य र स्वव्यस्थापन, खोज, अन्वेषण, तार्किकता जस्ता भाषासम्बद्ध जीवनोपयोगी सिपहरूलाई यथासम्भव एकीकृत गरिने छ ।

## ५. सिकाइ सहजीकरण प्रक्रिया

सिकाइ सहजीकरण पाठ्यक्रमलाई कक्षाकोठामा प्रभावकारी रूपमा हस्तान्तरण गर्ने विधि हो । भाषा शिक्षणमा भाषिक सिपको विकासका लागि सिकाइ सहजीकरण प्रक्रिया अपरिहार्य हुन्छ । भाषा शिक्षणका क्रममा विद्यार्थीलाई सक्रिय गराएर सिकाइलाई विद्यार्थीकेन्द्रित बनाउनुपर्छ । यसका लागि कक्षाकोठामा बहुभाषिक, स्थिति भएमा पहिलो भाषा र दोस्रो भाषाका रूपमा नेपाली शिक्षणका विधिमा ध्यान पुऱ्याउनुपर्छ । सिकाइ सहजीकरण प्रक्रिया पाठ्यक्रमको उद्देश्य, विषयवस्तु, विद्यार्थीको पृष्ठभूमि, स्थानीय स्रोत साधनको उपलब्धता आदिमा निर्भर हुन्छ । यो व्यक्तिगत र सामूहिक अभ्यासमा पनि आधारित हुन्छ । यस पाठ्यक्रममा सिकाइ सहजीकरणका सिपमा आधारित विधागत शिक्षणमा जोड दिइने छ । भाषा शिक्षण भाषाका सिपहरूको शिक्षण हो । भाषाका सुनाइ, बोलाइ, पढाइ र लेखाइ सिपको एकीकृत शिक्षण गरेर नै भाषाको शिक्षण गरिन्छ । साहित्यिक विधा तथा प्रयोजनपरक पाठका माध्यमबाट भाषिक सिपको शिक्षण गर्ने भाषा सिकाइको मूल पक्ष हो । भाषा शिक्षणमा साहित्यिक

विधा र प्रयोजनपरक भेदहरूको निम्नअनुसार उपयोग गरिन्छ :

**(क) कविता**

कविता भाषाको लययुक्त भेद हो । कविताको शिक्षण गर्दा लयबोध, शब्दार्थ र वाक्यमा प्रयोग, संरचना (आदि, मध्य र अन्त्य) बोध, भावबोध, व्याख्या जस्ता क्रियाकलाप गराउनुपर्दछ । कविता शिक्षण गर्दा पूर्व तयारी, पठन वा श्रवण र पठनपश्चात्का चरणमा बाँडी पठन पृष्ठभूमि, उद्देश्य निर्धारण, प्रश्नको सूची, प्रश्नोत्तर, भावबोध जस्ता क्रियाकलाप गराउनुपर्दछ । यसका लागि नमुना कविता दिई अनुकरणात्मक लेखन गराउने र सिर्जनात्मक अभ्यास पनि गराउनुपर्दछ ।

**(ख) कथा**

कथा आख्यानात्मक विधा हो । आख्यानात्मक स्वरूपका कारण कथा रुचिपूर्ण हुन्छ । कथा शिक्षण गर्दा उच्चारण, गति, यतिसहित हाउभाउपूर्ण पठन गराइन्छ । कथाबाट कथाकथन, घटना वर्णन, घटना टिपोट, बोध, प्रश्नोत्तर, भाव वर्णन र अनुकरणात्मक तथा स्वतन्त्र सिर्जनात्मक अभ्यास गराउनुपर्छ । पठन क्रियाकलापलाई योजनाबद्ध रूपमा प्रस्तुत गराउन कथा विधा उपयोगी हुन्छ । कथा शिक्षण गर्दा पूर्वपठन, पठन र पठनपश्चात्का चरणमा बाँडी पूर्वानुमान गर्ने, सहकार्यात्मक पठन, छलफल र प्रस्तुतीकरण गर्ने तथा प्रश्न निर्माण गराउने क्रियाकलाप पनि गराउनुपर्छ ।

**(ग) निबन्ध**

निबन्ध गद्य विधा हो । निजात्मक र वस्तुपरक अनुभूतिका लागि निबन्ध उपयुक्त विधा हो । निबन्ध शिक्षण गर्दा शब्दार्थ र वाक्यमा प्रयोग, पठनबोध, विषयबोध, बुँदाटिपोट, व्याख्या, सारांश, प्रश्नोत्तर, अनुच्छेद लेखन र स्वतन्त्र लेखन जस्ता क्रियाकलाप गराउनुपर्छ । यो लेखाइ सिप विकासका लागि उपयुक्त विधा हो । परियोजना कार्य, घटना अध्ययन, कक्षा छलफल र प्रस्तुतीकरण जस्ता क्रियाकलाप गराएर निबन्ध लेखन क्रियाकलाप गराउनुपर्छ ।

**(घ) जीवनी**

जीवनी भाषाको गद्य भेद हो । जीवनीबाट विद्यार्थीलाई घटना वर्णन, घटना लेखन, बुँदाटिपोट, प्रश्नोत्तर, सारांश लेखन र जीवनी लेखन जस्ता अभ्यास गराउनुपर्छ । जीवनी लेखनसँगसम्बद्ध गराएर अन्तर्वाता, परियोजना कार्य, घटना अध्ययन जस्ता क्रियाकलाप गराउनुपर्छ । जीवनी शिक्षणबाट मूलतः भाषाका पढाइ र लेखाइ सिपको विकास हुने भए पनि लेखन अभ्याससम्बन्धी क्रियाकलाप बढी प्रभावकारी हुन्छ । यसका लागि नमुना जीवनी प्रस्तुत गर्दै अनुकरणात्मक जीवनीमा अभ्यास गराई स्वतन्त्र अभ्यास गराउनुपर्छ ।

**(ङ) रूपक**

रूपक भनेको अभिनयात्मक विधा हो । यसमा पात्रले परिस्थिति, अवस्था, विषयवस्तु र व्यक्ति विशेषको चारित्रिक भूमिकालाई ध्यानमा राखेर हाउभाउसहित भूमिका निर्वाह गर्छ । यो कथ्य भाषासँग सम्बन्धित भएकाले मौखिक अभिव्यक्तिका माध्यमले व्यक्तिका भावना, चारित्र आदिको प्रदर्शन गरिन्छ । नाटक, एकाङ्की, संवाद, वादविवाद, मनोवाद, वक्तृता आदिका माध्यमबाट रूपकीय प्रस्तुति गरिन्छ । तसर्थ रूपकको प्रकारअनुसार हाउभाउ प्रदर्शन गरी विचारको प्रस्तुतीकरण र व्यवहार गर्ने, अभिनयात्मक ढङ्गबाट अरूले गरेका व्यवहारको अनुकरण गर्ने, जीवन्त रूपमा मौखिक भाषाको प्रयोग गर्ने, तार्किक क्षमताको विकास गर्ने जस्ता क्रियाकलापबाट रूपक शिक्षण गर्नुपर्छ । साथै अभिनयात्मक कलाका अतिरिक्त रूपक विधाबाट अन्य भाषिक सिपको पनि अभ्यास गराउन सकिन्छ ।

### (च) प्रयोजनपरक पाठहरू

दैनिक जीवनमा प्रयोगमा आउने विभिन्न समसामयिक का ज्ञान, सिप एवम् विविध प्राविधिक र पारिभाषिक शब्दका माध्यमबाट भाषा सिकाइमा सहजता प्रदान गर्नका लागि यस तहमा प्रयोजनपरक रचनाहरू समावेश गरिएको छ । यसमा सिकारुका दैनिक जीवनयापन र व्यावसायिक क्षेत्रमा आवश्यक पर्ने ज्ञान, सिप, अभिवृद्धि, मूल्य र काम गर्ने तत्परतालाई व्यावहारिक रूपले उपयोग गर्न सक्ने गरी स्वास्थ्य, योग तथा चिकित्सा, कृषि, वन तथा वातावरण, पर्यटन, जलस्रोत र ऊर्जा, सञ्चार, विज्ञान तथा प्रविधि, समाज, संस्कृति र शिक्षा, कानून, प्रशासन र व्यवस्थापन, अर्थ, उद्योग र वाणिज्य जस्ता विषयमा आधारित रचनालाई समावेश गरिएको छ । यस्ता रचनाका माध्यमबाट विद्यार्थीले वाणिज्य, अर्थ, विज्ञान, स्वास्थ्य, कानून, शिक्षा, योग जस्ता विषयको रचनात्मक, प्रयोजनपरक भाषिक प्रयोग र संरचनाको अभ्यास गराइने छ । प्रयोजनपरक पाठहरूलाई रोचक बनाउनका लागि साहित्यिक विधाका रूपमा प्रस्तुत गरिने छ । सिकाइ सहजीकरणका क्रममा विभिन्न प्रयोजनपरक शीर्षक दिई तिनमा अनुकरणात्मक, निर्देशनात्मक र स्वतन्त्र लेखनको अभ्यास गराइन्छ । उदाहरणमा आधारित पाठ वा रचनाको अभ्यास, पाठको मौखिक र लिखित अभिव्यक्ति, समूह छलफल र प्रस्तुतीकरण, परियोजना र खोजमूलक कार्य गराउने अभ्यास गराउनुपर्दछ । त्यस्तै आवश्यकतानुसार प्रचलित र सान्दर्भिक विद्युतीय सञ्चार माध्यममा उपलब्ध उपयोगी सामग्रीको अध्ययन गरी कक्षामा प्रस्तुत गर्न लगाउनुपर्छ ।

### ७. विद्यार्थी मूल्याङ्कन प्रक्रिया

मूल्याङ्कन गर्दा निर्माणात्मक र निर्णयात्मक दुई किसिमका प्रक्रिया अपनाइने छ । निर्णयात्मक मूल्याङ्कन गर्दा आन्तरिक र बाह्य गरी दुई तरिका अवलम्बन गरिने छ । निर्णयात्मक मूल्याङ्कनका लागि निर्माणात्मक मूल्याङ्कनमा उपयोग गरिएका विभिन्न प्रक्रिया, साधनहरू तथा तिनको अभिलेखीकरणलाई समेत आधार बनाउन सकिने छ । निर्माणात्मक मूल्याङ्कन शिक्षण सिकाइ सहजीकरण प्रक्रियाकै निरन्तरता मानिने भएकाले यसलाई निरन्तर मूल्याङ्कनका रूपमा प्रयोग गर्न सकिन्छ ।

स्तरोन्नति तथा कक्षोन्नतिका लागि शैक्षिक सत्रको अन्तमा निर्णयात्मक मूल्याङ्कन अन्तिम परीक्षाका माध्यमबाट गरिने छ । निर्माणात्मक वा निरन्तर मूल्याङ्कनमा क्षेत्रीय अध्ययन, परियोजना कार्य, अध्ययन भ्रमण, घटना अवलोकन तथा अध्ययन, सिर्जनात्मक तथा रचनात्मक कार्य, विद्युतीय सञ्चार माध्यममा प्राप्त सान्दर्भिक सामग्रीको अध्ययन र प्रस्तुति, सिकारुका कार्यकलापको निरीक्षण, व्यक्तिगत र सामूहिक छलफल, लिखित परीक्षा, हाजिरीजवाफ, प्रश्नोत्तर, कक्षाकार्यको परीक्षण, भाषिक व्यवहारको निरन्तर अवलोकन र तिनको अभिलेखीकरण जस्ता साधनहरूको उपयोग गरिने छ ।

नेपाली भाषाको मूल्याङ्कनमा सक्षमता र सिकाइ उपलब्धिमा लेखिएका भाषिक सिपको मापन गरिने छ । विद्यार्थीको भाषिक सिपगत सक्षमताको मापनगर्ने प्रश्नहरूको निर्माण गर्दा व्याकरण र शब्दभण्डारसम्बन्धी प्रश्नहरूसमेत भाषिक एकाइ र रचनामा केन्द्रित गरिने छ । व्याकरणको मूल्याङ्कन कार्यमूलक प्रकृतिको हुने छ । प्रश्नहरू विद्यार्थीको भाषिक दक्षताका अतिरिक्त रचनात्मक र समालोचनात्मक क्षमतालाई पनि सम्बोधन गर्ने खालका हुने छन् ।

#### (क) आन्तरिक मूल्याङ्कन

आन्तरिक तथा प्रयोगात्मक मूल्याङ्कनका लागि प्रत्येक विद्यार्थीहरूको कार्यसञ्चयिका फाइल बनाई सोको आधारमा उनीहरूको कार्य र उनीहरूले गरेका कार्य र उनीहरूमा आएको व्यवहार परिवर्तनका अभिलेख राखी सोका आधारमा अङ्क प्रदान गर्नुपर्दछ । सिकाइका क्रममा कक्षाकोठामा कक्षागत शिक्षण सिकाइको अभिन्न अङ्गका रूपमा गृहकार्य, कक्षाकार्य, परियोजना कार्य, सामुदायिक कार्य, सह/अतिरिक्त क्रियाकलाप, एकाइ परीक्षा, मासिक परीक्षा जस्ता मूल्याङ्कन साधनहरूको प्रयोग गर्न सकिने छ । यस्तो मूल्याङ्कनका लागि विद्यार्थीको अभिलेख राखी त्यही अभिलेखका आधारमा सिकाइस्तर निर्धारण गर्न सकिन्छ । आवश्यकतानुसार सुधारात्मक तथा उपचारात्मक शिक्षण सिकाइ क्रियाकलाप सञ्चालन गर्नुपर्छ । विशेष सिकाइ आवश्यकता भएका विद्यार्थीका लागि विषय शिक्षकले नै उपयुक्त प्रक्रिया अपनाई मूल्याङ्कन गर्नुपर्ने छ । यस विषयमा निर्माणात्मक मूल्याङ्कन प्रक्रियाको महत्त्वपूर्ण भूमिका रहेको हुन्छ । विद्यार्थीहरूले के कति सिक्ने भन्ने कुरा पत्ता लगाई नसिकेको भए कारण पहिचान गरी पुनः सिकाइनुपर्छ । आन्तरिक मूल्याङ्कनको भार २५% छुट्याइएको छ । यस विषयको आन्तरिक मूल्याङ्कनमा कक्षा सहभागिता, कक्षा कार्य/परियोजना कार्य, विषयवस्तुको मूल्याङ्कन तथा आन्तरिक परीक्षाबाट प्राप्त विद्यार्थीको सिकाइ उपलब्धिलाई समेटिनु पर्दछ ।

यस खण्डको मूल्याङ्कन विद्यार्थीले व्यक्तिगत तथा समूह कार्य तथा परियोजनाको गुणस्तरको आधारमा विद्यालय तहमा गठन गरिने मूल्याङ्कन समितिले गर्ने छ भने तोकिएको निकायबाट यसको प्राविधिक परीक्षण हुने छ । आन्तरिक मूल्याङ्कनका आधारहरू र अङ्क विभाजन निम्नानुसार हुने छ :

## आन्तरिक मूल्याङ्कनको विस्तृतीकरण

क्र.सं	क्षेत्र	परीक्षण गर्ने पक्ष	अङ्क भार	मूल्याङ्कनका आधार
१.	सहभागिता	कक्षा सहभागिता	३	विद्यार्थीको दैनिक हाजिरीको अभिलेखलाई आधार लिने भाषिक सिप विकासका लागि व्यक्तिगत, युगल र समूहगत आदि कक्षागत सिकाइ सहभागितालाई आधार मान्ने
२.	कक्षा कार्य/परियोजना कार्य	कक्षा कार्य/परियोजना कार्य	६	सुनाइ, बोलाइ, पढाइ, लेखाइ सिप विकाससम्बद्ध लिखित तथा मौखिक प्रस्तुति, गृहकार्य, कक्षा कार्य वा भाषिक सिप विकाससम्बन्धी परियोजना कार्यको प्रतिवेदन र अन्तर्वार्ता (भाइबा) लाई आधार लिने
३.	विषय वस्तुगत मूल्याङ्कन	(क) सुनाइ	३	रेडियो, क्यासेट, मोबाइल वा अन्य विद्युतीय सामग्रीबाट समाचार, संवाद, साहित्यिक अभिव्यक्ति, वा अन्य सन्देशमूलक गद्यांश सुनाएर अनुमान, पूर्वानुमान, प्रश्नोत्तर, शब्दबोध, अर्थबोध, सन्दर्भबोध, भावबोध, कथाकथन, घटना वर्णन, मुख्य बुँदा टिपोट आदिसँग सम्बन्धित प्रश्नहरू सोधी भन्न वा लेख्न लगाउने । वा १५० देखि २०० शब्दसम्मको कुनै गद्यांश वा पद्यांश (अदृष्टांश) सुनाएर अनुमान, पूर्वानुमान, प्रश्नोत्तर, शब्दबोध, अर्थबोध, सन्दर्भबोध, भावबोध, कथाकथन, घटना वर्णन, मुख्य बुँदा टिपोट आदिसँग सम्बन्धित प्रश्नहरू सोध्ने ।

	(ख) बोलाइ (अ) मौखिक वर्णन/ कथा कथन	३	कुनै पत्रपत्रिका वा कुनै लिखित सामग्रीबाट १५० शब्दसम्मको गद्यांश वा पद्यांश दिएर गति, यति, लय मिलाएर भावानुकूल सस्वर वाचन गर्न लगाउने । (यसरी वाचन गर्दा स्पष्टता, भाषिक शुद्धता, गति, यति, लय र हाउभाउ जस्ता पक्षमा विशेष ख्याल गर्ने)
	(आ) सस्वर वाचन)	३	कुनै पत्रपत्रिका वा कुनै लिखित सामग्रीबाट १५० शब्दसम्मको गद्यांश वा पद्यांश दिएर गति, यति, लय मिलाएर भावानुकूल सस्वर वाचन गर्न लगाउने ।
४	त्रैमासिक परीक्षा	त्रैमासिक परीक्षाको अङ्कबाट	(यसरी वाचन गर्दा स्पष्टता, भाषिक शुद्धता, गति, यति, लय र हाउभाउ जस्ता पक्षमा विशेष ख्याल गर्ने)
	जम्मा		२५

द्रष्टव्य : आन्तरिक मूल्याङ्कनका आधारको विस्तृत विवरण आन्तरिक मूल्याङ्कन कार्यविधिका आधार मा हुने छ ।

(ख) बाह्य मूल्याङ्कन

(आ) भाषिक सिप (पढाइ र लेखाइ) कक्षा ११

क्र.सं	भाषिक सिप (पढाइ र लेखाइ)	विषयक्षेत्र	अङ्कभार
१.	वर्ण पहिचान	व्याकरण	३
२.	वर्णविन्यास	व्याकरण	३
३.	पदवर्ग पहिचान	व्याकरण	२
४.	शब्दनिर्माण	व्याकरण	४

५.	रूपायन र पदसङ्गति	व्याकरण	३
६.	काल, पक्ष, भाव र वाच्य	व्याकरण	५
७.	शब्दस्रोत र शब्दकोशीय प्रयोग	व्याकरण	२
८.	वाक्यान्तरण	व्याकरण	३
९.	पठनबोध	प्रयोजनपरक रचना	८
१०.	बुँदाटिपोट र सारांश	गद्य रचना	२ + ३ = ५
११.	पाठगत बोध (सन्दर्भमा आधारित छोटो उत्तरात्मक)	कथा, कविता, निबन्ध, जीवनी, रूपक, प्रयोजनपरक रचना	८
१२.	पाठगत बोध (समीक्षात्मक)	कथा, कविता, निबन्ध, जीवनी, प्रयो जनपरक रचना	४+४=८
१३.	स्वतन्त्र रचना	निबन्ध	८
१४.	प्रतिक्रिया लेखन	सामयिक विषय	४
१५.	व्यावहारिक लेखन	व्यावहारिक लेखन, पत्ररचना	४
१६.	प्रतिवेदन तथा टिप्पणी लेखन	प्रतिवेदन र टिप्पणी	५
	जम्मा		७५

### कक्षा १२

क्र.सं	भाषिक सिप (पढाइ र लेखाइ)	विषयक्षेत्र	अङ्कभार
१.	अक्षर संरचना	व्याकरण	३
२.	वर्णविन्यास	व्याकरण	३
३.	पदवर्ग पहिचान	व्याकरण	३
४.	शब्दनिर्माण	व्याकरण	३
५.	कारक र विभक्ति तथा पदसङ्गति	व्याकरण	४
६.	काल, पक्ष, भाव र वाच्य	व्याकरण	५
७.	वाक्यान्तरण	व्याकरण	४
८.	पठनबोध	प्रयोजनपरक रचना	८
९.	बुँदाटिपोट र सारांश	गद्य विधा	२+३=५

१०.	पाठगत बोध (सन्दर्भमा आधारित उत्तरात्मक)	उपन्यास, कथा, कविता, निबन्ध, जीवनी र प्रयोजनपरक रचना	८
११.	पाठगत बोध (समीक्षात्मक)	उपन्यास, कथा, कविता, निबन्ध, जीवनी, प्रयोजनपरक रचना	४+४=८
१२.	स्वतन्त्र रचना	निबन्ध	८
१३.	प्रतिक्रिया लेखन	प्रतिक्रिया	४
१४.	व्यावहारिक लेखन	व्यावहारिक लेखन, पत्ररचना	४
१५.	प्रतिवेदन तथा टिप्पणी लेखन	प्रतिवेदन	५
	जम्मा		७५

# सामाजिक अध्ययन

कक्षा १२

पाठ्यघण्टा : ३

वार्षिक कार्यघण्टा : ९६ घण्टा

## १. परिचय

शिक्षालाई ज्ञान, सिप, अभिवृत्ति, नेतृत्वकला आर्जन गर्ने, समालोचनात्मक विश्व दृष्टिकोणका आधारमा समाजका घटना परिघटनाको व्याख्या गर्ने र समाज रूपान्तरणमा महत्वपूर्ण योगदान गर्ने साधनका रूपमा लिइन्छ। शिक्षालाई समयसापेक्ष बनाउन यसलाई समुदायसँग जोड्नुपर्दछ। व्यक्तिले आफू, परिवार, समाज, राष्ट्र र विश्व परिवेशसँग सामञ्जस्य कायम गर्दै समयानुकूल, स्वच्छ, स्वस्थ र मर्यादित जीवन निर्वाहका लागि क्रियाशील रहन शारीरिक, मानसिक तथा संवेगात्मक व्यवस्थापन गर्नु आवश्यक हुन्छ। मानव जीवनलाई सहज, उन्नत एवम् सुसंस्कृत बनाउन र सामाजिक सम्बन्धहरूलाई न्यायपूर्ण, सौहार्द्रपूर्ण एवम् सहयोगात्मक बनाउँदै लैजान शिक्षाको महत्वपूर्ण भूमिका हुन्छ। समाजलाई समुन्नति र सभ्यतातर्फ अघि बढाउने एउटा प्रभावकारी माध्यमका रूपमा शिक्षालाई लिइन्छ। विश्वमा ज्ञान, विज्ञान र प्रविधिलगायत राजनीति, अर्थतन्त्र, संस्कृति र सामाजिक सम्बन्धहरूमा समेत परिवर्तनहरू आइरहेका हुन्छन्। यस्ता परिवर्तनलाई सम्बोधन गर्न समुदायलाई शिक्षाको पाठ्यक्रमका रूपमा लिई सिकाइका कार्यहरू सञ्चालन गर्नुपर्दछ। विद्यार्थीहरूलाई विद्यालय तहदेखि नै समाज र वातावरणसँग अन्तरक्रिया गर्ने अवसर प्रदान गर्नु पनि आवश्यक छ। यस्तै किशोरकिशोरीमा उत्पन्न हुने द्विविधाहरू व्यवस्थापन गरी कार्यमूलक जीवनमा प्रवेश गर्दा आवश्यक पर्ने जीवनोपयोगी सिपहरू विद्यालय तहमै हासिल गराउनु औचित्यपूर्ण हुन्छ। विद्यालय शिक्षाको राष्ट्रिय पाठ्यक्रम प्रारूप, २०७६ अनुसार कक्षा १२ का विद्यार्थीमा समाजको अध्ययनसहित जीवनोपयोगी सिप विकास गराई मानवीय मूल्य र मान्यतासहित लोकतान्त्रिक समाजमा अनुकूलन हुन सक्ने सक्षम नागरिक तयार पार्ने उद्देश्यले सामाजिक अध्ययनको यो पाठ्यक्रम तयार गरिएको छ।

यस पाठ्यक्रममा समाज तथा सामाजिकीकरण, मानवसमाजको उद्भव र विकास, नेपाल र विश्वभूगोल, नेपालको सामाजिक तथा सांस्कृतिक मूल्य मान्यताहरू, नेपाल र विश्वको ऐतिहासिक विकासक्रम, नागरिक सचेतना र संविधान, जीवनोपयोगी सिप, वातावरण र जनसाङ्ख्यिकी जस्ता विषय समेटिएको छ। यस पाठ्यक्रमले ज्ञान, सिप, अभिवृत्ति र मूल्यको विकासमा जोड दिएकाले अध्ययन अध्यापनमा सैद्धान्तिकभन्दा व्यावहारिक र प्रयोगात्मक पक्षमा बढी जोड दिनुपर्ने हुन्छ। यस विषयका लागि साप्ताहिक ३ पाठ्यघण्टा र वार्षिक कुल ९६ कार्यघण्टा छुट्याइएको छ। विषयवस्तुमा ७२ कार्यघण्टाको सैद्धान्तिक तथा २४ कार्यघण्टाको व्यावहारिक अभ्यास समावेश गरिएको छ। मूल्याङ्कनलाई सिकाइ सहजीकरण प्रक्रियाको अभिन्न अङ्गका रूपमा प्रयोग गर्नुपर्ने पक्षलाई जोड दिइएको

छ। यसका लागि विद्यार्थीमा आवश्यक सामाजिक अध्ययनको ज्ञान, सिप, अभिवृत्ति र मूल्यहरू हासिल भए नभएको परीक्षण हुने गरी मूल्याङ्कनका विभिन्न विधि तथा साधनहरू निर्माण तथा प्रयोग गर्नुपर्दछ। मूल्याङ्कन प्रक्रियालाई सहजीकरण गर्नका लागि मूल्याङ्कनका आधारसमेत यस पाठ्यक्रममा समावेश गरिएको छ।

यस पाठ्यक्रममा परिचय, विषयगत रूपमा अपेक्षित ज्ञान, सिप, अभिवृत्ति, मूल्य र कार्य तत्परतालाई समेटि त्यसको क्रियात्मक स्वरूपमा सक्षमता निर्धारण गरिएको छ। विषयगत विशिष्टपन र मौलिकतालाई समेटि सिकाइ सहजीकरणका विधि तथा प्रक्रिया प्रस्तुत गरिएको छ। यसमा आन्तरिक र बाह्य मूल्याङ्कनका विधि तथा प्रक्रियासमेत उल्लेख गरी विद्यार्थी मूल्याङ्कनलाई व्यवस्थित गरिएको छ।

## २. तहगत सक्षमता

सामाजिक अध्ययन विषयको अध्ययनपश्चात् विद्यार्थीहरूमा निम्नानुसारका सक्षमता हासिल हुने छन् :

१. समाज तथा सामाजिकीकरण अवधारणाको विकास र व्यावहारिक अभ्यास
२. मानवसमाजको उद्भव र विकास सम्बद्ध विविधताको विश्लेषण
३. नेपाल र विश्वभूगोलका प्रमुख ऐतिहासिक घटनाहरूको प्रस्तुति
४. नेपालको सामाजिक तथा सांस्कृतिक मूल्य मान्यताहरूको पहिचान गर्दै समावेशीकरण र विविधताको सम्मान
५. नेपाल र विश्वको ऐतिहासिक विकासक्रमको प्रस्तुति
६. नागरिक सचेतना र वर्तमान संविधानका प्रमुख विशेषताहरूको विश्लेषण
७. जीवनोपयोगी शिक्षामा निर्णय प्रक्रिया, समस्या समाधान, सञ्चार, तनाव व्यवस्थापन र अन्तरवैयक्तिक सिप र सम्बन्धको प्रयोग र उपयोग
८. पारिस्थितिक पद्धति, जनसाङ्ख्यिक स्वरूप, बसाइँसराइको गतिशीलता, र यौन तथा प्रजनन शिक्षासम्बन्धी समीक्षात्मक विश्लेषण

## ३. कक्षागत सिकाइ उपलब्धि

कक्षा १२ को अन्त्यमा विद्यार्थीहरूमा निम्नानुसारका सिकाइ उपलब्धिहरू हासिल हुने छन् :

एकाइ	विषयवस्तुको क्षेत्र	सिकाइ उपलब्धि
१.	समाज तथा सामाजिकीकरण	१.१ सामाजिक अध्ययन विषयको परिचय दिन १.२ सामाजिक अध्ययन विषयको महत्त्व र विकासक्रम बताउन १.३ सामाजिक अध्ययनका सिपहरू (बौद्धिक, सामाजिक सांस्कृतिक, सञ्चार र प्रविधि) को पहिचान गरी दैनिक जीवनमा प्रयोग गर्न

		<p>१.४ समाज र समुदायको अवधारणा बताउँदै यसका विशेषताहरू चित्रण गर्न</p> <p>१.५ प्राविधिक तथा व्यावसायिक शिक्षाको समाजसँग रहेको सम्बन्ध पहिल्याउन</p> <p>१.६ सामाजिकीकरणको अवधारणा बताउन</p> <p>१.७ सामाजिकीकरणका तत्वहरूको सूची बनाई व्याख्या गर्न ।</p>
२.	मानवसमाजको उद्भव र विकास	<p>२.१ मानव समाजको उद्भव र विकास क्रम बताउन</p> <p>२.१.१ ढुङ्गे युगको संस्कृतिको विवेचना गर्न</p> <p>२.१.२ कृषि युगको सुरुआत र विकासक्रमको व्याख्या गर्न</p> <p>२.१.३ औद्योगिक युग र उत्तर आधुनिक युगको निर्माण र प्रभावको विश्लेषण गर्न</p> <p>२.२ सामाजिक विविधताको अर्थ बताउँदै यसका आयामहरूको विश्लेषण गर्न</p> <p>२.३ सिप र प्रविधिमा आधारित समाजका विशेषताहरू पत्ता लगाउन</p> <p>२.४ मानव समाजको विकासका विभिन्न चरणहरूसँग आजको मानव समाजको तुलना गर्न ।</p>
३.	नेपाल र विश्व भूगोल	<p>३.१ विश्व मानचित्रमा नेपालको अवस्थिति पत्ता लगाउन</p> <p>३.२ नेपालको भौगोलिक विभाजन (धरातलीय स्वरूप, नदी, हावापानी) लाई नक्साको माध्यमद्वारा देखाउन</p> <p>३.३ प्रशासनिक आधारमा नेपालको विभाजन गरी नक्साद्वारा देखाउन</p> <p>३.४ हावापानी तथा खेतीपातीका लागि नेपालमा पश्चिमी वायु र मनसुनी वायुको प्रभाव पत्ता लगाउन</p> <p>३.५ नेपालको जनजीवनमा भौगोलिक विविधताले पार्ने प्रभावको विश्लेषण गर्न</p> <p>३.६ नेपालका सन्दर्भमा निम्नलिखित प्राकृतिक स्रोतहरूको वर्तमान अवस्था, सम्भावना र उपयोगिताको विश्लेषण गर्न : भूमि, वन, खनिज, जलस्रोत, नदी, कुण्ड र तालहरू, सौन्दर्य र पर्यटन</p> <p>३.७ अवस्थिति (ध्रुव, अक्षांश, देशान्तर र अन्तर्राष्ट्रिय तिथि रेखा) को आधारभूत अवधारणा बताउन</p> <p>३.८ अक्षांश र देशान्तरका आधारमा समय र दुरीको गणना गर्न</p>

		<p>३.९ महादेश र महासागरहरूको सामान्य परिचय दिन</p> <p>३.१० भूकम्प, बाढी, पहिरो हिमपहिरो जस्ता विपद्को अवधारणा बताउँदै यसका कारण र परिणामहरूको विवेचना गर्न</p> <p>३.११ माथि उल्लेखित विपद्बाट बच्न अपनाइने सावधानीका उपायहरूको खोजी गर्न</p> <p>३.१२ विपत् व्यवस्थापनमा स्थानीय साधन र सिपको प्रयोग गर्दै अरूलाई सहभागी हुन प्रेरित गर्न र आफू पनि सहभागी हुन</p>
४.	नेपालको सामाजिकतथा सांस्कृतिक मूल्य मान्यताहरू	<p>४.१ नेपालका मौलिक जातजाति, धर्म, संस्कृति, भाषाभाषी, पेसा, चाडपर्व, प्रथा, परम्परा, रहनसहन, मूल्य र मान्यताहरूको खोजी गर्न</p> <p>४.२ नेपालीकला (वास्तुकला, चित्रकला, मूर्तिकला, र काष्ठकला) का विशेषता र महत्त्व बताउन</p> <p>४.३ नेपालमा रहेका भौगोलिक, जातीय, धार्मिक, लैङ्गिक तथा यौनिक अल्पसङ्ख्यकहरूको पहिचान गर्दै राज्यका तर्फबाट उनिहरूका लागि व्यवस्था गरिएको सामाजिक सुरक्षाको व्यवस्था विश्लेषण गर्न</p> <p>४.४ शारीरिक र मानसिक अपाङ्गता भएका व्यक्तिहरूले सामाजिक सुरक्षाका रूपमा प्राप्त गरेका सेवा सुविधाहरूको खोजी गर्न</p> <p>४.५ ज्येष्ठ नागरिक र उनीहरू प्रतिको सम्मानका लागि राज्यबाट निर्धारण गरिएका नीतिको खोजी गर्दै आफू पनि ज्येष्ठ नागरिकको सम्मानमा लाग्न</p> <p>४.६ नेपालमा सामाजिक सुरक्षासम्बन्धी प्रावधानको विश्लेषण गर्दै यसको व्यावहारिक अभ्यासमा देखिएका कठिनाइहरूको विवेचना गर्न ।</p>
५.	नेपाल र विश्वको ऐतिहासिक विकासक्रम	<p>५.१ किरातकाल, लिच्छविकाल र मध्यकाल (मल्लकाल) को सामाजिक, आर्थिक एवम् राजनीतिक अवस्था चित्रण गर्न</p> <p>५.२ नेपालको आधुनिक इतिहासअन्तर्गत :</p> <p>५.२.१ नेपाल एकीकरण अभियानको चर्चा गर्न</p> <p>५.२.२ राणाशासन कालको सामाजिक र आर्थिक परिवर्तन पत्ता लगाउन</p>

		<p>५.२.३ वि.सं. २००७ देखि २०१७ सालसम्मको राजनीतिक घटनाक्रमको वर्णन गर्न</p> <p>५.२.४ वि.सं. २०१७-२०४६ सालसम्मको राजनीतिक घटनाक्रमको सूची बनाउन</p> <p>५.२.५ वि.सं. २०४६ देखि हालसम्मको राजनीतिक घटनाक्रमहरूको चर्चा गर्न</p> <p>५.३ औद्योगिक क्रान्ति र विश्वको आर्थिक सामाजिक क्षेत्रमा यसका प्रभावहरूको विश्लेषण गर्न</p> <p>५.४ विश्वमा लोकतन्त्रको उदय, विकासक्रम र वर्तमान अवस्थाको विवेचना गर्न ।</p>
६.	संविधान र नागरिक सचेतना	<p>६.१ नेपालको संवैधानिक विकासक्रमको चर्चा गर्न</p> <p>६.२ नेपालको संविधान २०७२ का प्रमुख राजनीतिक, कानुनी, आर्थिक र सांस्कृतिक विशेषताहरूको विश्लेषण गर्न ।</p> <p>६.३ नेपालका सन्दर्भमा वालिग मताधिकारको अवधारणा प्रष्ट्याउँदै सङ्घ, प्रदेश र स्थानीय तहको निर्वाचन प्रक्रियाबारे व्याख्या गर्न</p> <p>६.४ नेपालको राष्ट्रिय सुरक्षाको अवधारणा बताउँदै नेपालमा राष्ट्रिय सुरक्षाको वर्तमान अवस्थाको विश्लेषण गर्न</p> <p>६.५ नेपालमा रहेको प्राविधिक तथा व्यावसायिक शिक्षासम्बन्धी नीतिगत र संस्थागत व्यवस्थाको विवेचना गर्न ।</p>
७.	जीवनोपयोगी सिप	<p>७.१ जीवनोपयोगी सिपको व्याख्या गर्न र सामाजिक तथा पेसागत जीवनमा तिनको प्रयोग गर्न</p> <p>७.२ सामाजिक अध्ययन र जीवनोपयोगी शिक्षामा निर्णय प्रक्रिया, समस्या समाधान, सञ्चार, तनाव व्यवस्थापन र अन्तरवैयक्तिक सिप र सम्बन्धको विश्लेषण गरी प्रयोग र प्रस्तुत गर्न</p>
८.	वातावरण र जनसाङ्ख्यिकी	<p>८.१ नेपालमा प्राविधिक प्रणाली र जैविक विविधताको अवस्थाको विवेचना गर्न</p> <p>८.२ जलवायु परिवर्तनका कारण, असर र असर कम गर्ने उपायहरूको खोजी गर्न</p> <p>८.३ दिगो विकासको अवधारणा उल्लेख गर्न</p> <p>८.४ नेपालको जनसाङ्ख्याको आकार, बोनोट र वितरणको अवस्था पहिल्याउँदै तथ्याङ्कको खोजी, प्रस्तुति र विश्लेषणको प्रया</p>

		<p>गात्मक अभ्यास गर्न</p> <p>८.५ स्थानीय स्तरमा जन्म, मृत्यु र बसाइँसराइको अवस्थाको सर्वेक्षण गर्दै प्रतिवेदन तयार गर्न</p> <p>८.६ नेपालमा बसाइँसराइको प्रवृत्ति, कारण र आर्थिक सामाजिक प्रभावको खोजी गर्न</p> <p>८.७ नेपालमा सहरीकरणको मापदण्ड, विस्तार र प्रवृत्तिको चर्चा गर्न</p> <p>८.८ नेपालमा जनसङ्ख्या व्यवस्थापनका उपायहरूको खोजी गर्न</p> <p>८.९ किशोरावस्थामा हुने यौनआवेग र संवेगको पहिचान र व्यवस्थापन गर्ने उपयुक्त उपायहरूको खोजी र प्रयोग गर्न ।</p>
--	--	--

#### ४. विषयवस्तुको क्षेत्र र क्रम

क्र.स.	विषयक्षेत्र	विषयवस्तु (कक्षा १२)	कार्य घण्टा
१.	समाज तथा सामाजिकीकरण	<p>१.१ सामाजिक अध्ययनको परिचय महत्व र विकासक्रम</p> <p>१.२ सामाजिक अध्ययनका सिपहरू (वैद्विक, सामाजिक साँस्कृतिक, संचार र प्रविधि)</p> <p>१.३ समाज र समुदायको अवधारणा र विशेषताहरू</p> <p>१.४ प्राविधिक तथा व्यवसायिक शिक्षा र समाजबिचको सम्बन्ध</p> <p>१.५ सामाजिकीकरण अवधारणा, तत्त्वहरू</p> <p>१.६ सामाजिक परिवर्तन र प्रविधिको प्रभाव र प्रयोग</p> <p>१.७ सामाजिक अन्तरक्रिया अवधारणा र व्यावहारिक अभ्यास</p>	१२
२.	मानव समाजको उद्भव र विकास	<p>२.१ मानव जातिको उद्भव र विकास</p> <p>२.१.१ ढुङ्गे युगको संस्कृति</p> <p>२.१.२ कृषि युगको सुरुआत र विकास</p> <p>२.१.३ औद्योगिक युग र उत्तर आधुनिक युगकोनिर्माण र प्रभाव</p> <p>२.२ सामाजिक विविधताको अर्थ रआयामहरू</p> <p>२.३ सिप र प्रविधिमा आधारित समाज</p>	८

३.	नेपाल र विश्व भूगोल	<p>३.१ नेपालको भूगोल</p> <p>३.१.१ विश्व मानचित्रमा नेपाल</p> <p>३.१.२ नेपालको भौगोलिक विभाजन (धरातलिय स्वरूप, नदी, हावापानी)</p> <p>३.१.३ नेपालमा पश्चिमी वायु र मनसुनी वायुको प्रभाव</p> <p>३.१.४ नेपालको भौगोलिक विविधताको जनजीवनमा प्रभाव</p> <p>३.१.५ प्रशासनिक आधारमा नेपालको विभाजन</p> <p>३.१.६ प्राकृतिक स्रोतहरू : भूमि, वन, खनिज, जलश्रोत, नदी, कुण्ड र तालहरू, सौन्दर्य र पर्यटन</p> <p>३.२ विश्वको भूगोल</p> <p>३.२.१ अवस्थिति (ध्रुव, अक्षांश, देशान्तर, अन्तर्राष्ट्रिय तिथि रेखा)</p> <p>३.२.२ महादेश र महासागरहरूको सामान्य परिचय</p> <p>३.२.३ अक्षांश र देशान्तरका आधारमा समय र दुरीको गणना</p> <p>३.३ विपत् व्यवस्थापन : नेपालमा विद्यमान प्रयास र अभ्यास</p> <p>३.३.१ भूकम्प, बाढी, पहिरो हिमपहिरो (अवधारणा, कारण, परिणाम र सावधानीका उपाय)</p> <p>३.३.२ विपत् व्यवस्थापनमा स्थानीय सिपको प्रयोग र जनसहभागिता</p>	१६
४.	नेपालको सामाजिक तथा सांस्कृतिक मूल्य मान्यताहरू	<p>४.१ नेपालको सामाजिक एवम् सांस्कृतिक अवस्था</p> <p>४.१.१ जातजाति, धर्म, संस्कृति, भाषाभाषी, पेसा, चाडपर्व, प्रथा, परम्परा, रहनसहन, मूल्य र मान्यता</p> <p>४.१.२ नेपालीकला (वास्तुकला, चित्रकला, मूर्तिकला, र काष्ठकला) विशेषता र महत्त्व</p> <p>४.२ नेपालमा समावेशीकरण परिचय र प्रावधान (भौगोलिक, जातीय, धार्मिक, लैङ्गिक तथा यौनिक अल्पसङ्ख्यक, अपाङ्गता)</p>	१२

		<p>४.३ जेष्ठ नागरिक र उनीहरूको सम्मान</p> <p>४.४ नेपालमा सामाजिक सुरक्षासम्बन्धी प्रावधान र यसको अभ्यास</p>	
५.	नेपाल र विश्वको ऐतिहासिक विकासक्रम	<p>५.१ नेपालको इतिहास</p> <p>५.१.१ किरातकाल, लिच्छविकाल र मध्यकाल (मल्लकाल) (सामाजिक, आर्थिक एवम् राजनीतिक अवस्था)</p> <p>५.१.२ नेपालको आधुनिक इतिहास :</p> <p>५.१.२.१ नेपाल एकीकरण अभियान</p> <p>५.१.२.२ राणाशासन (सामाजिक, आर्थिक परिवर्तन)</p> <p>५.१.२.३ वि.सं. २००७ देखि २०१७ सालसम्मको राजनीतिक घटनाक्रम</p> <p>५.१.२.४ वि.सं. २०१७-२०४६ सालसम्मको राजनीतिक घटनाक्रम</p> <p>५.१.२.५ वि.सं. २०४६ देखि हालसम्मको राजनीतिक घटनाक्रम</p> <p>५.२ विश्वको इतिहास</p> <p>५.२.१ औद्योगिक क्रान्ति र यसका प्रभाव</p> <p>५.२.२ विश्वमा लोकतन्त्रको उदय, विकासक्रम र वर्तमान अवस्था</p>	१४
६.	संविधान र नागरिक सचेतना	<p>६.१ संविधान र नागरिक सचेतना</p> <p>६.१.१ नेपालको संवैधानिक विकासक्रम र नेपालको संविधान २०७२ का प्रमुख विशेषताहरू (राजनीतिक, कानुनी, आर्थिक र सांस्कृतिक)</p> <p>६.१.२ निर्वाचन प्रक्रिया (सङ्घ, प्रदेश र स्थानीय तह) र बालिग मताधिकार</p> <p>६.१.३ नेपालको राष्ट्रिय सुरक्षाको अवधारणा र वर्तमान अवस्था</p> <p>६.१.४ प्राविधिक तथा व्यवसायिक शिक्षासम्बन्धी नीतिगत र संस्थागत व्यवस्था</p>	१२

७.	जीवनोपयोगी सिप	<p>७.१ जीवनोपयोगी सिपको परिचय र यसको वर्गीकरण</p> <p>७.२ निर्णय प्रक्रिया</p> <p>७.२.१ निर्णयको परिचय र प्रकार</p> <p>७.२.२ निर्णय प्रक्रियाका चरण, प्रयोग र अभ्यास</p> <p>७.२.३ निर्णयमा अनिर्णित हुने अवस्थाको पहिचान</p> <p>७.३ समस्या समाधान</p> <p>७.३.१ समस्याको परिचय र पहिचान</p> <p>७.३.२ समस्या समाधानका चरण</p> <p>७.३.३ समस्या समाधानको व्यावहारिक अभ्यास</p> <p>७.४ सञ्चार</p> <p>७.४.१ सञ्चार सिपको पहिचान र प्रकार</p> <p>७.४.२ सञ्चारका अवरोधहरू</p> <p>७.४.३ प्रभावकारी सञ्चार र प्रभावकारी सम्बन्ध</p> <p>७.४.४ प्रभावकारी सञ्चारका माध्यम र अभ्यास</p> <p>७.४.५ सामाजिक सञ्जालको सदुपयोग</p> <p>७.५ तनाव व्यवस्थापन</p> <p>७.५.१ तनावको अर्थ, सिर्जित अवस्था र असर</p> <p>७.५.२ तनाव व्यवस्थापनका उपायहरू : समर्पण, प्रतिरोध र सम्झौता तथा तिनका व्यावहारिक अभ्यास</p> <p>७.५.३ तनाव व्यवस्थापनका रणनीति</p> <p>७.५.४ द्वन्द्व, तनाव, द्वन्द्व रूपान्तरण र व्यवस्थापनको प्रक्रिया र अभ्यास</p> <p>७.५.५ तनाव व्यवस्थापनमा मनोसामाजिक परामर्श, योग र ध्यानको प्रयोग</p> <p>७.६ अन्तरवैयक्तिक सिप र सम्बन्ध</p> <p>७.६.१ अन्तरवैयक्तिक सिपको अर्थ र महत्त्व</p> <p>७.६.२ अन्तरवैयक्तिक सम्बन्ध सुधारका उपाय</p> <p>७.६.३ अन्तरवैयक्तिक सम्बन्ध र सामाजिक सञ्जाल</p> <p>७.६.४ असल नेतृत्वका लागि अन्तरवैयक्तिक सम्बन्ध व्यवस्थापन</p> <p>७.६.५ टोलीकार्य र नेतृत्व विकास</p>	१४
----	----------------	--	----

द.	वातावरण र जनसाङ्ख्यिकी	<p>द.१ पारिस्थितिक पद्धति र वातावरण</p> <p>द.१.१ पारिस्थितिक प्रणाली र जैविक विविधता,</p> <p>द.१.२ जलवायु परिवर्तन</p> <p>द.१.३ दिगो विकास</p> <p>द.२ जनसाङ्ख्यिकी र नेपालको जनसङ्ख्या</p> <p>द.२.१ नेपालको जनसङ्ख्याको आकार, बनोट र वितरण</p> <p>द.२.२ जनसाङ्ख्यिक तत्त्वहरू: जन्म, मृत्यु र बसाइँसराइ</p> <p>द.२.३ नेपालमा बसाइँसराइको प्रवृत्ति, कारण र यसको आर्थिक सामाजिक प्रभाव</p> <p>द.२.४ नेपालमा सहरीकरणको मापदण्ड, विस्तार र प्रवृत्ति</p> <p>द.२.५ नेपालमा जनसङ्ख्या व्यवस्थापनका उपायहरू</p> <p>द.३ यौन तथा प्रजनन शिक्षा</p> <p>द.३.१ किशोर किशोरीहरूका लागि यौनिकता शिक्षा: यौन आवेग र संवेगको पहिचान र व्यवस्थापन</p>	८
		जम्मा	९६

५. प्रयोगात्मक तथा परियोजना कार्यमा समावेश गर्न सकिने केही क्रियाकलापहरू

एकाइ	विषयवस्तुको क्षेत्र	कार्य घण्टा	नमुना क्रियाकलाप
१.	समाज तथा सामाजिकीकरण	२	<ul style="list-style-type: none"> <li>● तपाईं बसोबास गर्ने ठाउँमा कक्षा ८, ९ र १० मा अध्ययनरत कुनै पनि भाइबहिनीका १० जना अविभावकहरूलाई भेटी सामाजिक सञ्जालको प्रयोगका कारण उनीहरूका छोराछोरीको सामाजिकीकरण र अध्ययनमा पारेको प्रभावका बारेमा सोधखोज गरी आएको प्रतिक्रियालाई टिपोट गर्नुहोस् र सो प्रतिक्रियाका आधारमा एउटा प्रतिवेदन तयार गर्नुहोस् ।</li> </ul>
२.	मानव समाजको उद्भव र विकास	२	<ul style="list-style-type: none"> <li>● तपाईं बसोबास गरेको समुदायमा आजसम्म पनि के कस्ता परम्परागत सिप तथा प्रविधिहरू प्रयोग भइरहेका रहेछन् ? खोजी गरी प्रतिवेदन तयार गर्नुहोस् । प्रतिवेदनमा सम्भव भएसम्म हरेक सिप तथा प्रविधिको फोटो, परिचय, निर्माण विधि र प्रयोगको क्षेत्र (कृषि, उद्योग, पर्यटन आदि) समेत समेट्नुहोस् ।</li> </ul>

३.	नेपाल र विश्व भूगोल	३	<ul style="list-style-type: none"> <li>● कक्षाका सबै विद्यार्थीलाई पाँच समूहमा विभाजन गर्नुहोस् । हरेक समूहले तल दिइएका एक/एकओटा काम गर्नुहोस् : हरेक समूहले एउटा ठुलो प्लाइउडको व्यवस्था गर्नुहोस् । सो प्लाइउडमा सेतो रङको चार्टपेपर टाँस्नुहोस् । अब ग्राफ विधिको प्रयोग गरी ६०:३६ आकारमा नेपालको नक्सा बनाउनुहोस् । सो नक्सामा निम्नानुसार विवरण सङ्केतका आधारमा देखाउनुहोस् । समूह १ : नेपालको धरातलीय स्वरूप समूह २ : मुख्य हावापानी क्षेत्र समूह ३ : मुख्य नदी क्षेत्र (कोशी, गण्डकी र कर्णाली) समूह ४ : भौगोलिक विभाजन अनुसार मुख्य पेसाका क्षेत्रहरू समूह ५ : नेपालको राजनीतिक र प्रशासनिक विभाजन</li> <li>● तपाईं बसोबास गर्ने ठाउँका स्थानीय ज्येष्ठ नागरिकहरूलाई भेटी सो स्थानमा विगतमा आएका विभिन्न प्राकृतिक विपत्हरूका बारेमा सोधखोज गरी ती विपत् व्यवस्थापन कसरी भएका रहेछन् भन्ने तथ्य समेत समेटेर एउटा प्रतिवेदन तयार गर्नुहोस् ।</li> </ul>
४	नेपालको सामाजिक तथा सांस्कृतिक मूल्य मान्यताहरू	३	<ul style="list-style-type: none"> <li>● तपाईं बसोबास गरेको वडाका केही ज्येष्ठ नागरिकलाई भेटी उहाँहरूले सामाजिक सुरक्षाबापत राज्यका तर्फबाट प्राप्त गरिरहनु भएका सेवा सुविधाहरूका बारेमा सोधखोज गर्नुहोस् र प्राप्त प्रतिक्रियाहरूलाई टिपोट गर्दै जानुहोस् । त्यस्तै उहाँहरूले सामाजिक सुरक्षाबापत राज्यबाट अपेक्षा गर्नुभएको थप सेवा सुविधाहरूका बारेमा समेत सोधखोज गरी प्रतिवेदन तयार गर्नुहोस् ।</li> </ul>
५.	नेपाल र विश्वको ऐतिहासिक विकासक्रम	२	<ul style="list-style-type: none"> <li>● तपाईंको समुदायमा भएका सबैभन्दा ज्येष्ठ नागरिकलाई भेटी उहाँ तपाईंको उमेरको हुँदा र अहिले तल दिइएका क्षेत्रमा के कस्तो अवस्था थियो, सोध्नुहोस् र आजको अवस्थसँग तुलना गर्नुहोस् ।</li> </ul>

			<table border="1"> <thead> <tr> <th>क्षेत्र</th> <th>पहिले</th> <th>अहिले</th> </tr> </thead> <tbody> <tr> <td>आम्दानीको स्रोतका क्षेत्र</td> <td></td> <td></td> </tr> <tr> <td>खना</td> <td></td> <td></td> </tr> <tr> <td>कपडा</td> <td></td> <td></td> </tr> <tr> <td>यातायात</td> <td></td> <td></td> </tr> <tr> <td>सञ्चार</td> <td></td> <td></td> </tr> <tr> <td>वरपरको पर्यावरण</td> <td></td> <td></td> </tr> </tbody> </table> <p>आफ्ना अविभावकहरूसँग सोधखोज गरेर तपाईंसहित सात पुस्ता समेटेर आफ्नो वंश वृक्ष तयार गर्नुहोस् ।</p>	क्षेत्र	पहिले	अहिले	आम्दानीको स्रोतका क्षेत्र			खना			कपडा			यातायात			सञ्चार			वरपरको पर्यावरण																																													
क्षेत्र	पहिले	अहिले																																																																	
आम्दानीको स्रोतका क्षेत्र																																																																			
खना																																																																			
कपडा																																																																			
यातायात																																																																			
सञ्चार																																																																			
वरपरको पर्यावरण																																																																			
६.	संविधान र नागरिक सचेतना	२	<p>● तपाईं बसोबास गर्ने जिल्लाबाट प्रतिनिधि सभा, प्रदेश सभा र स्थानीय तहमा प्रतिनिधित्व गर्ने प्रतिनिधिहरूको विवरण तल दिइएको तालिकामा भर्नुहोस् :</p> <table border="1"> <thead> <tr> <th colspan="4">प्रतिनिधि सभा तथा प्रदेश सभा</th> </tr> <tr> <td colspan="2">प्रदेश : .....</td> <td colspan="2">जिल्ला : .....</td> </tr> <tr> <td colspan="2"></td> <td colspan="2">निर्वाचन क्षेत्र सङ्ख्या : .....</td> </tr> <tr> <th>क्षेत्र न.</th> <th>निर्वाचित प्रतिनिधिको नाम</th> <th colspan="2">राजनीतिक दल</th> </tr> </thead> <tbody> <tr> <td>प्रतिनिधि सभा</td> <td>१.</td> <td colspan="2"></td> </tr> <tr> <td>क</td> <td></td> <td colspan="2"></td> </tr> <tr> <td>ख</td> <td></td> <td colspan="2"></td> </tr> <tr> <td>प्रतिनिधि सभा</td> <td>२.</td> <td colspan="2"></td> </tr> <tr> <td>क</td> <td></td> <td colspan="2"></td> </tr> <tr> <td>ख</td> <td></td> <td colspan="2"></td> </tr> <tr> <th colspan="4">स्थानीय तह</th> </tr> <tr> <td colspan="4">जिल्ला : ..... स्थानीय तहको नाम : .....</td> </tr> <tr> <th>पद</th> <th>प्रतिनिधिको नाम</th> <th>राजनीतिक दल</th> <th>ठेगाना</th> </tr> <tr> <td>प्रमुख</td> <td></td> <td></td> <td></td> </tr> <tr> <td>उपप्रमुख</td> <td></td> <td></td> <td></td> </tr> <tr> <td>वडा अध्यक्ष</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	प्रतिनिधि सभा तथा प्रदेश सभा				प्रदेश : .....		जिल्ला : .....				निर्वाचन क्षेत्र सङ्ख्या : .....		क्षेत्र न.	निर्वाचित प्रतिनिधिको नाम	राजनीतिक दल		प्रतिनिधि सभा	१.			क				ख				प्रतिनिधि सभा	२.			क				ख				स्थानीय तह				जिल्ला : ..... स्थानीय तहको नाम : .....				पद	प्रतिनिधिको नाम	राजनीतिक दल	ठेगाना	प्रमुख				उपप्रमुख				वडा अध्यक्ष			
प्रतिनिधि सभा तथा प्रदेश सभा																																																																			
प्रदेश : .....		जिल्ला : .....																																																																	
		निर्वाचन क्षेत्र सङ्ख्या : .....																																																																	
क्षेत्र न.	निर्वाचित प्रतिनिधिको नाम	राजनीतिक दल																																																																	
प्रतिनिधि सभा	१.																																																																		
क																																																																			
ख																																																																			
प्रतिनिधि सभा	२.																																																																		
क																																																																			
ख																																																																			
स्थानीय तह																																																																			
जिल्ला : ..... स्थानीय तहको नाम : .....																																																																			
पद	प्रतिनिधिको नाम	राजनीतिक दल	ठेगाना																																																																
प्रमुख																																																																			
उपप्रमुख																																																																			
वडा अध्यक्ष																																																																			

			<table border="1"> <tr> <td>वडा सदस्य १</td> <td></td> <td></td> <td></td> </tr> <tr> <td>वडा सदस्य २</td> <td></td> <td></td> <td></td> </tr> <tr> <td>वडा सदस्य ३</td> <td></td> <td></td> <td></td> </tr> <tr> <td>वडा सदस्य ४</td> <td></td> <td></td> <td></td> </tr> </table>	वडा सदस्य १				वडा सदस्य २				वडा सदस्य ३				वडा सदस्य ४			
वडा सदस्य १																			
वडा सदस्य २																			
वडा सदस्य ३																			
वडा सदस्य ४																			
७.	जीवनोपयोगी सिप	६	<ul style="list-style-type: none"> <li>● तपाईंको एक मिल्ने साथीले धूमपान गर्न लागेको छ । उसले तपाईंलाई समेत धूमपान गर्न कर गरिरहेको छ तर तपाईंलाई उसको यो बानी मन पर्दैन । आफूभन्दा बलियो र भिन्न सामाजिक परिवेशबाट आएकाले तपाईं उसलाई केही भनिहाल्न पनि सक्नुहुन्न । अब तपाईं यस्तो कुलतबाट टाढा बस्न के निर्णय गर्नुहुन्छ अनि त्यो निर्णय कसरी कार्यान्वयन गर्नुहुन्छ ? प्रतिवेदन तयार पारी प्रस्तुत गर्नुहोस् ।</li> <li>● तलको घटना अध्ययन गर्नुहोस् र दिइएका प्रश्नका आधारमा घटना विश्लेषण गरी प्रतिवेदन तयार गर्नुहोस् :</li> <li>● तपाईंको एक साथी साथीहरूको सङ्गतमा परेर लागुपदार्थको दुर्व्यसनमा फसेको छ । ऊ परिवारलाई यो कुरा भन्न सकिरहेको छैन तर घरमा सामानहरू हराउने, पैसा हराउने समस्याले अभिभावकहरू हैरान छन् । उसको समूहका साथीहरूबाट पनि ऊ खतरामा छ भने पुलिस प्रशासनबाट पनि पक्राउ पर्ने सम्भावना छ । अभिभावकहरूमा छोरामा आएको परिवर्तनमा थोरै आशङ्का रहे पनि के गर्ने नगर्ने केही गर्न सकिरहेका छैनन् । अब सोच्नुहोस्</li> </ul> <p>(क) माथिका घटनाको मुख्य समस्या केसँग सम्बन्धित छ ?</p> <p>(ख) समस्याका कारणहरू के के हुन सक्छन् ?</p> <p>(ग) समस्या समाधानका उपायहरू के के हुन सक्छन् ?</p> <ul style="list-style-type: none"> <li>● तपाईंको समुदायमा रहेको कुनै एक समस्या पहिचान गर्नुहोस् । यो समस्या कसरी समाधान गर्न सकिन्छ ? समस्या समाधानका लागि योजना तयार</li> </ul>																

			<p>पार्ने, समाधानको प्रयास गर्ने र समाधानका लागि आफूले गरेका प्रयास र त्यसको प्रगतिसम्बन्धी सम्पूर्ण योजना तयार पारी प्रस्तुत गर्नुहोस् ।</p> <ul style="list-style-type: none"> <li>● तपाईंको कक्षाको एक साथीको एउटा सकारात्मक र एउटा सुधारापेक्षी व्यवहार सङ्केत गरी सङ्केत गरिएको व्यवहार सुधारका लागि साथीले गर्नुपर्ने कार्यकलापको सूची बनाई सकारात्मक कार्यलाई यथावत् राख्न र सुधारापेक्षी व्यवहारलाई सुधार गर्न सुझाव दिनुहोस् र साथीले उसको सूचीअनुसारको व्यवहार पालन गरेनगरेको अवलोकन गरी टिपोट तयार गर्नुहोस् अनि साथीको व्यवहारबाट आफूले समेत सुधार गर्नुपर्ने पक्ष समेत टिपोट गर्नुहोस् ।</li> <li>● पछिल्लो १५ दिनमा आफूले सामना गर्नुपरेको तनाव उल्लेख गरी उक्त तनावका कारण र त्यसलाई समाधान गर्न आफूले गरेका प्रयास उल्लेख गरी प्रस्तुत गर्नुहोस् ।</li> </ul>
८.	वातावरण र जनसाङ्ख्यिकी	४	<ul style="list-style-type: none"> <li>● स्थानीय पालिका कार्यालयमा गएर आफ्नो पालिकाको जन्म, मृत्यु र बसाइँसराइसम्बन्धी तथ्याङ्कहरूको खोजी गर्नुहोस् । प्राप्त तथ्याङ्कलाई तालिका र स्तम्भचित्रमा देखाउँदै प्राप्त आँकडाको विश्लेषण गर्नुहोस् । (पालिका कार्यालयले स्थानीय स्तरमा गर्ने विभिन्न प्रकारका सर्वेक्षण र अध्ययनका बारेमा सोधखोज गरी सो कार्यमा तपाईं आफू पनि संलग्न हुन सक्नुहुन्छ ।)</li> <li>● नजिकैको सहरमा बसोबास गर्दै गरेका केही व्यक्तिहरूलाई भेटी सहररीकरणका कारणले उनीहरूले भोगेका समस्या तथा कठिनाइहरूका बारेमा सोधखोज गरी 'सहररीकरणका कारणले निम्तिएका समस्या र समाधानका उपायहरू' शीर्षकमा एउटा प्रतिवेदन तयार गर्नुहोस् ।</li> </ul>

			<ul style="list-style-type: none"> <li>विषय शिक्षकको सहयोगमा कक्षामा पढ्ने पाँच/पाँच जना साथीहरूको समूह बनाउनुहोस् । किशोरावस्थामा आफुमा के कस्ता यौन आवेग र संवेगहरू देखिएका छन्, साथीहरूबिच छलफल गर्नुहोस् र प्राप्त बुँदाहरूलाई टिपोट गर्दै जानुहोस् । ती आवेग र संवेगहरूलाई के कसरी व्यवस्थापन गर्न सकिन्छ भन्ने बारेमा पनि सहपाठी साथीहरूबिच छलफल गर्नुहोस् । प्राप्त भएका बुँदाहरूलाई माथि जसरी नै टिपोट गर्दै जानुहोस् । प्राप्त भएका बुँदाहरूका आधारमा 'किशोरावस्थामा हुने यौन आवेग र संवेगको पहिचान र व्यवस्थापनका उपायहरू' शीर्षकमा एउटा प्रतिवेदन तयार गर्नुहोस् । आफ्नो समूहको प्रतिवेदनसँग अन्य समूहको प्रतिवेदन के कति मिल्छ, तुलनासमेत गर्नुहोस् ।</li> </ul>
	जम्मा	२४	

#### ६. सिकाइ सहजीकरण प्रक्रिया

सामाजिक अध्ययन विषयले विद्यार्थीहरूलाई राष्ट्र र राष्ट्रियताप्रति समर्पित, नागरिक मूल्य मान्यताप्रति सचेत र समसामयिक परिवेशको विश्लेषण र समालोचनात्मक दृष्टिकोणसहितको नागरिक तयार गर्ने उद्देश्य राखेको छ । यस विषयको पाठ्यक्रम सामाजिक जीवनसँग सम्बन्धित विभिन्न क्षेत्रहरूलाई समेटेर एकीकृत रूपमा तयार गरिएको छ । यसमा उल्लेख गरिएका विषयवस्तुहरूको अध्ययन अध्यापन गराउँदा सबै क्षेत्रलाई उत्तिकै महत्त्व दिनुपर्ने हुन्छ । सम्बन्धित विषयवस्तुको एकीकृत रूपमा सहजीकरण गराई विषयवस्तुको ज्ञान, सिप र धारणाको विकास गराउनुपर्छ । विद्यार्थीहरूमा सैद्धान्तिक र व्यावहारिक दुवै पक्षको विकास गराई सकारात्मक व्यवहारको जगेर्ना गर्नु यस विषयको मुख्य ध्येय हो ।

विद्यार्थीमा समालोचनात्मक तथा सकारात्मक सोचको विकास, प्रतिभा प्रस्फुटन, सिर्जनात्मक सिपको विकास र विविध प्रकारका सामाजिक सिपको विकास गरी व्यवहारमा सुधार गर्दै समाजको नेतृत्व गर्न सक्ने क्षमताको विकास गराउने जस्ता मूलभूत उद्देश्यहरू यस विषयले राखेको छ । सामाजिक अध्ययनका विषयवस्तुको व्यावहारिक ज्ञान दिनका लागि कक्षाभित्र वा बाहिर आआफ्नो कक्षाकोठा, विद्यालय, परिवार, टोल, विभिन्न समूह, समुदायलगायत स्थानीय सरकारसँग सम्बन्धित क्रियाकलापहरू गराउनुपर्ने छ । विषयवस्तुलाई जस्ताको तस्तै कण्ठ गराउने शिक्षण पद्धतिलाई निरुत्साहन गरी विद्यार्थीहरूलाई आआफ्ना समुदायमा खोज गरी सिर्जनात्मक प्रतिभाको विकास गर्न

प्रोत्साहन गर्नुपर्ने छ ।, प्रतिवेदन, रेखाचित्र, वृत्तचित्र, स्तम्भ चित्र, तालिका, तस्बिर, नक्सा जस्ता सिर्जनशील कार्यमार्फत आवश्यक ज्ञान, सिप र अभिवृत्ति विकास गराउँदै सिर्जनशीलताको विकास गराउने लक्ष्य राखेको छ ।

यी सिपहरूको विकासका लागि सबै विद्यार्थीहरूलाई एकै खालको सहजीकरणले सम्भव नहुन पनि सक्छ । त्यसैले उनीहरूलाई बहुबौद्धिकताको सिद्धान्तानुरूप रुचि र क्षमताअनुसारका ज्ञान र सिप एवम् मूल्यहरूको विकास गर्न क्रियाकलापमा विविधता ल्याउनुपर्छ । यसका निम्ति योजनाबद्ध सिकाइ सहजीकरणको ठुलो भूमिका रहन्छ । विद्यार्थीहरूलाई “गर र सिक” भन्ने धारणाको अभिवृद्धि गराउनु सामाजिक अध्ययन विषयको मूल लक्ष्य हो । किशोर किशोरी आफैँले गरेर सिकेका कुरामा विश्वास गर्छन् । मनमा विश्वास जागेपछि उक्त सिकाइले व्यवहारमा सुधार ल्याउँछ । त्यसैले सामाजिक अध्ययन विषयमा सिकाइ सहजीकरण गर्दा विभिन्न प्रकारका विद्यार्थीकेन्द्रित शिक्षण विधिहरू प्रयोग गर्नुपर्छ । जस्तै :

- (क) प्रश्नोत्तर
- (ख) प्रदर्शन
- (ग) समस्या समाधान
- (घ) छलफल
- (ङ) अवलोकन
- (च) सोधखोज
- (छ) अभिनय
- (ज) परियोजना
- (झ) प्रयोग
- (ञ) घटना अध्ययन
- (ट) समालोचनात्मक चिन्तन र
- (ठ) सामुदायिक कार्य

यी विधिहरू नमुना मात्र हुन् । स्थानीय परिवेश, विषयवस्तुको प्रकृति र स्वरूपका आधारमा सिकाइ सहजीकरणमा विविधता ल्याउन सकिने छ । शिक्षकले सिकाइ सहजीकरण गर्दा विद्यार्थीको उमेर, तह, रुचि, बहुबौद्धिकता, मनोविज्ञान, सामाजिक पृष्ठभूमि, विद्यार्थी सङ्ख्या, शैक्षिक सामग्रीको उपलब्धता आदि समेतलाई ध्यान दिनुपर्ने हुन्छ । सहजीकरण गर्दा विद्यार्थीहरूको सहभागिता एवम् सामूहिक तथा सहयोगात्मक सिकाइलाई प्रोत्साहन गर्नुपर्छ । विद्यार्थीलाई समस्या समाधान गर्न गाह्रो वा अप्ठ्यारो परे को अवस्थामा उनीहरूका कमी कमजोरीलाई राम्ररी केलाई शिक्षकद्वारा समस्या समाधानमा सहयोग गर्नुपर्छ । विद्यार्थीहरू सिर्जना र प्रतिभाका भण्डार हुन् । त्यसैले उनीहरूका प्रतिभा प्रष्फुटनका लागि

उपयुक्त वातावरण सिर्जना गर्नुपर्छ । शिक्षकले एउटा सहजकर्ताका रूपमा विद्यार्थीहरूलाई सही बाटो देखाउन सहयोग पुऱ्याउनुपर्छ । उल्लिखित विधिहरूका अतिरिक्त कथाकथन, मन्थन, कार्यशाला विधि, प्रवचन विधि, सर्वे जस्ता विधिहरू पनि आवश्यकताअनुसार प्रयोग गर्नुपर्छ । सामाजिक अध्ययन विषय शिक्षण गर्दा सूचना प्रविधिको समेत सहयोग लिएर सिक्न सक्ने वातावरण तयार गर्नुपर्छ ।

### ७. विद्यार्थी मूल्याङ्कन प्रक्रिया

पाठ्यक्रमले निर्धारण गरेका उद्देश्यअनुरूप विद्यार्थीहरूले ज्ञान, सिप तथा अभिवृत्ति प्राप्त गर्न सके सकेनन् भन्ने कुरा पत्तालगाउने महत्त्वपूर्ण साधन मूल्याङ्कन हो । विद्यार्थीहरूको मूल्याङ्कन गर्दा विद्यार्थीहरूले अध्ययन गरेका विषयवस्तु व्यवहारमा प्रयोग गर्न सक्छन् सक्दैनन् भनी अध्ययन गर्नुपर्छ । यसका लागि आन्तरिक मूल्याङ्कनका लागि विभिन्न साधन र विधिहरूको सञ्चयिका अग्रिम रूपमा शिक्षकले तयार पारी विद्यार्थीहरूलाई उपलब्ध गराउनुपर्छ । यस विषयको पाठ्यक्रममा समावेश गरि एका तहगत सक्षमताहरू, कक्षागत सिकाइ उपलब्धिहरू र तिनका विषयवस्तु, सोसँग सम्बन्धित सिप, सिकाइ सहभागिता र सिकाइ सक्रियताका आधारमा विद्यार्थीहरूको सिकाइको मूल्याङ्कन गर्नुपर्दछ । यस्तो मूल्याङ्कन शिक्षण सिकाइ क्रियाकलापकै अभिन्न अङ्गका रूपमा सञ्चालन गरी विद्यार्थीको सिकाइ सुधारमा केन्द्रित हुनुपर्दछ ।

विद्यार्थीहरूको मूल्याङ्कन निर्माणात्मक र निर्णयात्मक दुवै प्रयोजनका लागि सञ्चालन गरिने छ । विद्यार्थीको निर्णयात्मक मूल्याङ्कनका लागि मूल्याङ्कनको कुल भारमध्ये २५ प्रतिशत आन्तरिक र ७५ प्रतिशत बाह्य मूल्याङ्कनबाट हुने छ । यसका लागि निर्माणात्मक मूल्याङ्कनको निर्धारित अभिलेखका आधारमा मूल्याङ्कनको कुल अङ्कको २५ प्रतिशत आन्तरिक मूल्याङ्कनका रूपमा र ७५ प्रतिशत बाह्य परीक्षाबाट समावेश गरी विद्यार्थीको सिकाइस्तर निर्धारण गरिन्छ ।

#### (क) आन्तरिक मूल्याङ्कन

आन्तरिक वा प्रयोगात्मक मूल्याङ्कनका लागि प्रत्येक विद्यार्थीहरूको कार्य सञ्चयिका फाइल बनाई सोका आधारमा उनीहरूले गरेका कार्य र उनीहरूमा आएको व्यवहार परिवर्तनका अभिलेख राखी सोका आधारमा अङ्क प्रदान गर्नुपर्दछ । सामाजिक अध्ययन विषय सिकाइका क्रममा कक्षाकोठामा कक्षागत शिक्षण सिकाइको अभिन्न अङ्गका रूपमा गृहकार्य, कक्षाकार्य, परियोजना कार्य, सामुदायिक कार्य, सह/अतिरिक्त क्रियाकलाप, एकाइ परीक्षा, मासिक परीक्षा जस्ता मूल्याङ्कन साधनहरूको प्रयोग गर्न सकिने छ । यस्तो मूल्याङ्कनका लागि विद्यार्थीको अभिलेख राखी त्यही अभिलेखका आधारमा सिकाइस्तर निर्धारण गर्न सकिन्छ । आवश्यकतानुसार उपचारात्मक शिक्षण सिकाइ क्रियाकलाप सञ्चालन गर्नुपर्छ । विशेष सिकाइ आवश्यकता भएका विद्यार्थीका लागि विषय शिक्षकले नै उपयुक्त प्रक्रिया अपनाई मूल्याङ्कन गर्नुपर्ने छ । यस विषयमा निर्माणात्मक मूल्याङ्कन प्रक्रियाको महत्त्वपूर्ण भूमिका रहेको हुन्छ । विद्यार्थीहरूले के कति सिके भन्ने कुरा पत्तालगाई नसिकेको भए कारण पहिचान

गरी पुनः सिकाइनुपर्छ । आन्तरिक मूल्याङ्कनको भार २५% छुटाइएको छ । यस विषयको आन्तरिक मूल्याङ्कनमा कक्षा सहभागिता, सकारात्मक व्यवहार प्रयोगात्मक तथा परियोजना कार्य, आन्तरिक परीक्षाबाट प्राप्त विद्यार्थीको सिकाइ उपलब्धिलाई समेटिनु पर्दछ ।

यस खण्डको मूल्याङ्कन विद्यार्थीले व्यक्तिगत तथा समूह कार्य तथा परियोजनाको गुणस्तरको आधार मा विद्यालय तहमा गठन गरिने मूल्याङ्कन समितिले गर्ने छ भने तोकिएको निकायबाट यसको प्राविधिक परीक्षण हुने छ । आन्तरिक मूल्याङ्कनका आधारहरू र अङ्क विभाजन निम्नानुसार हुने छ :

#### आन्तरिक मूल्याङ्कनको विस्तृतीकरण

क्र.स.	क्षेत्र	परीक्षण गर्ने पक्ष	अङ्क भार	मूल्याङ्कनका आधार
१.	सिकाइ सहभागिता	सिकाइ सहभागिता	३	सक्रिय सिकाइका लागि दैनिक कक्षा उपस्थिति, व्यक्तिगत, समूहगत र कक्षागत सिकाइ सहभागिता
२	सकारात्मक व्यवहार तथा व्यवहार परि वर्तन	सहयोग, सम्बन्ध, समन्वय, नेतृत्व, सहभागिता, ग्रहणशीलता	४	शिक्षक, साथी, अपाङ्गता भएका, जेष्ठ नागरिक, श्रमिकप्रति देखाउने व्यवहार, सहयोग, सहानुभूति, सामुदायिक कार्यमा देखाएको उत्सुकता नेतृत्व सिपमा आएको परिवर्तन अरुका अनुकरणीय, असल व्यवहार ग्रहण
३	प्रयोगात्मक तथा परियोजना कार्य	प्रयोगात्मक तथा परियोजना कार्य	१२	प्रत्येक एकाइबाट कम्तीमा एउटा परियोजना कार्य वा सामुदायिक कार्य वा क्षेत्र भ्रमणमा सहभागी गराउने, विद्यार्थीको सहभागिता, सक्रियता, योजना निर्माण, अवलोकन, अन्तर्वार्ता, तथ्याङ्क सङ्कलन, प्रतिवेदनतयारी र प्रस्तुतीकरणलाई आधारमानी सामूहिक वा व्यक्तिगतरूपमा मूल्याङ्कन गर्ने
४	विषयगत मूल्याङ्कन	त्रैमासिक परीक्षा	५	त्रैमासिक परीक्षाहरूको मूल्याङ्कनका अभिलेख
जम्मा			२४	

द्रष्टव्य : आन्तरिक मूल्याङ्कनका आधारहरूको विस्तृत विवरण आन्तरिक मूल्याङ्कन कार्यविधिमा तो किएको आधारमा हुने छ ।

### (ख) बाह्य मूल्याङ्कन

यस विषयको कुल भारमध्ये ७५ प्रतिशत भार बाह्य मूल्याङ्कनमार्फत् हुने छ । संज्ञान क्षेत्रका विभिन्न तहहरू विशेष गरी ज्ञान, सिप र प्रयोग तहमा पर्ने गरी अति छोटो उत्तर आउने प्रश्न, छोटो उत्तर आउने प्रश्न र लामो उत्तर आउने प्रश्न गरी तीन किसिमका प्रश्नहरू सोधिने छ । लामो उत्तर आउने प्रश्न समस्या समधान र विश्लेषण गर्ने खालको हुने छ । ती प्रश्नमा विद्यार्थीले दिएको जवाफको आधारमा उनीहरूको मूल्याङ्कन गरिने छ । प्रश्नहरू सैद्धान्तिक ज्ञानभन्दा पनि व्यावहारिक समस्याहरू समाधानमा जोड दिने खालका हुने छन् । मूल्याङ्कनलाई वस्तुगत बनाउन प्रश्नहरूलाई विशिष्ट बनाइने छ । बाह्य मूल्याङ्कनका लागि प्रश्नहरू पाठ्यक्रम विकास केन्द्रले तयार गरेको विशिष्टकरण तालिकाअनुसार तयार गर्नुपर्ने छ ।

सैद्धान्तिक मूल्याङ्कन  
विशिष्टीकरण तालिका, २०७८

कक्षा १२

पूर्णाङ्क: ७५

समय: २ घण्टा १५ मिनेट

विषय : सामाजिक अध्ययन

प्रश्न योजना तथा अङ्कभार वितरण

एकाइ	क्षेत्र/इकाइ	पाठ्यभार	ज्ञान १७ प्रतिशत			बोध २९ प्रतिशत			प्रयोग तथा सिप २७ प्रतिशत			उच्चदक्षता २७ प्रतिशत			जम्मा प्रश्नसङ्ख्या			जम्मा अङ्कभार		
			अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो	अति छोटो	छोटो	लामो
			१	समाज तथा सामाजिकीकरण	१२	१	१										१	१		१
२	मानवसमाजको उद्भव र विकास	८				१								१				५		
३	नेपाल र विश्व भूगोल	१६				१			१	१				२	१		२	५		
४	नेपालको सामाजिकतथा सांस्कृतिक मूल्य मान्यताहरू	१२	१	१							१			२	१		२	५		
५	नेपाल र विश्वको ऐतिहासिक विकासक्रम	१४	१			१	१							२	१		२	५		
६	संविधान र नागरिक सचेतना	१२									१	१		१	१		१	५		
७	जीवनोपयोगी शिक्षा	१२				१			१	१			१	२	१	१	२	५	८	
८	वातावरण र जनसाङ्ख्यिकी	१०				१						१		१	१		१	५		
९	जम्मा	९६	३	२		४	२	१	२	२	१	२	२	१	११	८	३	११	४०	२४

### प्रश्नका प्रकारहरू

प्रश्नका प्रकारहरू	सोधिने सङ्ख्या	समय विभाजन (मिनेट)	पूर्णाङ्क
अति छोटो प्रश्न	११	२०	$११ \times १ = ११$
छोटो प्रश्न	८	७२	$८ \times ५ = ४०$
लामो प्रश्न	३	४३	$३ \times ८ = २४$
जम्मा	२२	२ घन्टा १५ मिनेट	७५

### द्रष्टव्य :

- सबै प्रश्न अनिवार्य हुने छन् ।
- अति छोटो प्रश्न ११ ओटा सोधिने छन् र प्रत्येक प्रश्नको अंकभार १ हुनेछ ।
- छोटो प्रश्नहरू ८ ओटा हुनेछन् र प्रत्येकको अंकभार ५ हुनेछ ।
- लामो प्रश्नहरू ३ ओटा हुनेछन् र प्रत्येकको अंकभार ८ हुनेछ ।
- प्रश्नहरू माथि उल्लिखित ज्ञान, बोध, प्रयोग तथा सिप र उच्च दक्षताको प्रश्नहरू निर्धारित प्रतिशत भार मिल्ने गरी निर्माण गर्नुपर्ने छ ।

उच्च दक्षता अन्तर्गत, विश्लेषण, मूल्यांकन, सिर्जनात्मक र मूल्य सम्बन्धी प्रश्नहरू समावेश गर्नुपर्ने छ

**Technical and Vocational Stream**  
**Secondary Education Curriculum**  
**Mathematics**

**Grades: 11 and 12**

**Credit hours : 3**

**Annual Working Hours : 96**

**1. Introduction**

Mathematics is an essential in the field of engineering, medicine, natural sciences, finance and other social sciences. The branch of mathematics concerned with application of mathematical knowledge to other fields and inspires new mathematical discoveries. School mathematics is necessary as the backbone for higher study in different disciplines.

This course of Mathematics is designed for grade 11 and 12 students of engineering as a subject as per the curriculum structure prescribed by the National Curriculum Framework, 2076 of TEVT stream. The content areas of this curriculum are Algebra, Trigonometry, Analytic Geometry, Vectors, Statistics and Probability, and Calculus.

This course will be delivered using both the conceptual and theoretical inputs through demonstration and presentation, discussion, and group works as well as practical and project works in the real world context.

**2. Level-wise Competencies**

On completion of this course, students will have the following competencies:

1. Use basic properties of elementary functions and their inverse including linear, quadratic, reciprocal, polynomial, rational, absolute value, exponential, logarithm, sine, cosine and tangent functions.
2. Use principles of elementary logic to find the validity of statement and also acquire knowledge of matrix, sequence and series, and combinatory.
3. Make connections and present the relationships between abstract algebraic structures with familiar number systems such as the integers, real numbers and complex numbers.
4. Identify and derive equations for lines, circles, parabolas, ellipses, and hyperbolas, and identify the plane and its properties in space.
5. Apply knowledge of statistics and probability in daily life.

6. Use vectors in daily life.
7. Solve the problems related to limit, continuity and derivative and determine the extreme values of function in daily life.
8. Explain anti-derivatives as an inverse process of derivative and use them in various situations.

### 3. Grade-wise Learning Outcomes

On completion of the course, the students will be able to:

SN.	Content Domain/ area	Learning Outcomes	
		Grade 11	Grade 12
1.	Algebra	1.1 acquaint with logical connectives and construct truth tables. 1.2 prove set identities. 1.3 define interval and absolute value of real numbers. 1.4 Define function, domain and range of a function, inverse function. 1.5 Find inverse function of given invertible function. 1.6 Define sequence and series. 1.7 Classify sequences and series (arithmetic, geometric, harmonic). 1.8 Solve the problems related to arithmetic, geometric and harmonic sequences and series. 1.9 Establish relation among A.M, G. M and H.M.	1.1 Solve the problems related to permutation and combinations. 1.2 State and prove binomial theorems for positive integral index. 1.3 State binomial theorem for any integer (without proof). 1.4 Find the general term and binomial coefficient. 1.5 Define Euler's number. 1.6 Expand $e^x$ and $\log(1+x)$ using binomial theorem. 1.7 State and prove De Moivre's theorem. 1.8 find the sum of finite natural numbers, sum of squares of first n-natural numbers, sum of cubes of first n-natural numbers. 1.9 Define and apply mathematical induction.

		<p>1.10 Find the sum of infinite geometric series.</p> <p>1.11 Obtain transpose of matrix and verify its properties.</p> <p>1.12 Calculate minors, cofactors, adjoint, determinant and inverse of a square matrix.</p> <p>1.13 Define a complex number.</p> <p>1.14 Solve the problems related to algebra of complex numbers.</p> <p>1.15 Find conjugate and absolute value (modulus) of a complex numbers and verify their properties.</p> <p>1.16 express complex number in polar form.</p>	<p>1.10 Find square root of a complex number.</p> <p>1.11 Express complex number in polar form.</p> <p>1.12 Find the roots of a complex number by De Moivre's theorem.</p> <p>1.13 Solve the problems using properties of cube roots of unity.</p> <p>1.14 Define polynomial function and polynomial equation.</p> <p>1.15 Find roots of a quadratic equation.</p> <p>1.16 Establish the relation between roots and coefficient of quadratic equation.</p> <p>1.17 Form a quadratic equation with given roots.</p>
<b>2.</b>	<b>Trigonometry</b>	<p>2.1 Define inverse circular functions establish the relations on inverse circular functions.</p> <p>2.2 Find the general solution of trigonometric equations</p>	<p>2.1 Solve the problems using properties of a triangle (sine law, cosine law, tangent law, projection laws, and half angle laws).</p> <p>2.2 Solve the triangle (simple cases)</p>
<b>3.</b>	<b>Analytic geometry</b>	<p>3.1 find the length of perpendicular from a given point to a given line</p> <p>3.2 find the equation of</p>	<p>3.1 Find equation of circle</p> <p>3.2 Define tangent and normal of circle and find condition of tangency of a</p>

		<p>bisectors of the angles between two straight lines</p> <p>3.3 Write the condition of general equation of second degree in x and y to represent a pair of straight lines.</p> <p>3.4 Define homogenous second-degree equation in x and y.</p> <p>3.5 Find bisectors of the angles between pair of lines.</p>	<p>line at a point to the circle</p> <p>3.3 State the standard equations of parabola, Ellipse and hyperbola</p> <p>3.4 Define Coordinate axes and coordinate planes in three dimensions and coordinates of a point.</p> <p>3.5 Find distance between two points and section formula.</p> <p>3.6 Find direction ratios and direction cosines of a line.</p>
<b>4.</b>	<b>Vectors</b>	<p>4.1 Define vector.</p> <p>4.2 Find scalar product of two vectors.</p> <p>4.3 Find angle between two vectors.</p> <p>4.4 Interpret scalar product of vectors geometrically.</p> <p>4.5 Apply properties of scalar product of vectors in trigonometry and geometry.</p>	<p>4.1 Define vector product of two vectors, interpretation vector product geometrically.</p> <p>4.2 Solve the problems using properties of vector product.</p> <p>4.3 Apply vector product in geometry and trigonometry.</p>
<b>5.</b>	<b>Statistics and Probability</b>	<p>5.1 Define measure of dispersion</p> <p>5.2 Define and calculate range, mean deviation and quartile deviations and their coefficients.</p> <p>5.3 Define random experiment, sample space, event, equally likely</p>	<p>5.1 Define and calculate standard deviation, variance and coefficient of variation.</p> <p>5.2 Define and calculate skewness.</p> <p>5.3 Define dependent events and conditional probability</p>

		<p>cases, mutually exclusive events, exhaustive cases, favorable cases, independent and dependent events.</p> <p>5.4 Find the probability using two basic laws of probability. addition theorem of probability and Multiplication theorem of probability( independent case only)</p>	<p>(without proof)</p> <p>5.4 Define binomial distribution,</p> <p>5.5 Calculate mean and standard deviation of Binomial distribution</p> <p>5.6 Define conditional probability.</p> <p>5.7 State Bayes theorem and use it in solving problems.</p>
<b>6.</b>	<b>Calculus</b>	<p>6.1 Define limits of a function.</p> <p>6.2 State rules of finding limits</p> <p>6.3 Apply algebraic properties of limits.</p> <p>6.4 State basic theorems on limits of algebraic, trigonometric, exponential and logarithmic functions,</p> <p>6.5 Define and test continuity of a function.</p> <p>6.6 Define and classify discontinuity.</p> <p>6.7 Define derivative</p> <p>6.8 Interpret derivatives geometrically.</p> <p>6.9 Find the derivatives, derivative of a function by first principle</p>	<p>6.1 Find the derivatives of inverse trigonometric, exponential and logarithmic functions by definition.</p> <p>6.2 Define increasing/ decreasing functions,</p> <p>6.3 Find tangents and normal,</p> <p>6.4 Find extreme values of a function</p> <p>6.5 Perform standard integrals, integrals reducible to standard forms, integrals of rational function.</p> <p>6.6 Define differential equation and its order, degree, differential equations of first order and first degree,</p>

		<p>(algebraic, trigonometric exponential and logarithmic functions).</p> <p>6.10 Find the derivatives by using rules of differentiation (sum, difference, constant multiple, chain rule, product rule, quotient rule, power and general power rules).</p> <p>6.11 Find the derivatives of parametric and implicit functions.</p> <p>6.12 Calculate higher order derivatives.</p> <p>6.13 Define integration as reverse of differentiation.</p> <p>6.14 Evaluate the integral using basic integrals.</p> <p>6.15 Integrate by substitution and integration by parts method.</p> <p>6.16 Use definite integral to find the area under the given curve,</p> <p>6.17 Find the area between two curves.</p>	<p>6.7 Solve the differential equations with separable variables, homogenous, linear and exact differential equations.</p>
--	--	--	--

#### 4. Scope and Sequence of Contents

S.N.	Content area	Grade 11		Grade 12	
		Contents	W. Hrs. (Th.+Pr.)		W. Hrs. (Th.+Pr.)
1	Algebra	1.1 Logic and Set: Statements, logical connectives, truth tables, theorems based on set operations. 1.2 Real numbers: Geometric representation of real numbers, interval, absolute value. 1.3 Function <ul style="list-style-type: none"> <li>• Domain and range of a function, injective, surjective, bijective function, types of Function (algebraic, trigonometric, exponential, logarithmic), inverse function</li> </ul> 1.4 Sequence and series: <ul style="list-style-type: none"> <li>• Arithmetic, geometric, harmonic sequences and series and their properties</li> <li>• A.M, G.M, H.M and their relations,</li> </ul>	24	1.1 Permutation and combination: <ul style="list-style-type: none"> <li>• Basic principle of counting,</li> <li>• Permutation</li> <li>• Combination of things all different,</li> <li>• Properties of combination</li> </ul> 1.2 Binomial Theorem: <ul style="list-style-type: none"> <li>• Binomial theorem for a positive integral index, general term.</li> <li>• Binomial coefficient,</li> <li>• Euler's number.</li> <li>• Expansion of <math>e^x</math> and <math>\log(1+x)</math> (without proof)</li> </ul> 1.3 Sequence and series: <ul style="list-style-type: none"> <li>• Sum of first n natural numbers</li> <li>• Sum of squares of first n numbers</li> </ul>	24

		<ul style="list-style-type: none"> <li>Sum of infinite geometric series.</li> </ul> <p>1.5 Matrices and determinants:</p> <ul style="list-style-type: none"> <li>Matrix and its properties, transpose of a matrix, minors and cofactors, adjoint matrix</li> <li>Determinant of a square matrix,</li> <li>Inverse matrix,</li> <li>Properties of determinants (without proof)</li> </ul> <p>1.6 Complex number:</p> <ul style="list-style-type: none"> <li>Definition, imaginary unit, algebra of complex numbers, geometric representation, absolute (Modulus) value and conjugate of a complex numbers and their properties</li> <li>Polar form of complex numbers.</li> </ul>		<ul style="list-style-type: none"> <li>Sums of cubes of first n natural numbers</li> </ul> <p>1.4 Mathematical Induction</p> <ul style="list-style-type: none"> <li>Principle of mathematical induction and some application</li> </ul> <p>1.5 Complex Numbers :</p> <ul style="list-style-type: none"> <li>De' Moivre's Theorem and its application in finding the roots of unity and its properties.</li> </ul> <p>1.6 Quadratic Equation</p> <ul style="list-style-type: none"> <li>Solution of quadratic Equation</li> <li>Nature or roots of quadratic Equation.</li> </ul>	
2	Trigonometry	<p>2.1 Inverse circular functions</p> <p>2.2 Trigonometric equations and general values</p>	12	<p>2.1 Properties of a triangle</p> <p>Sine law, Cosine law, Tangent law, Projection laws, Half angle laws.</p> <p>2.2 Solution of triangle (simple cases)</p>	12

3	Analytic Geometry	<p>3.1 Straight line</p> <ul style="list-style-type: none"> <li>● Length of perpendicular from a given point to a given line, Bisectors of the angles between two straight lines.</li> </ul> <p>3.2 Pair of straight lines:</p> <ul style="list-style-type: none"> <li>● General equation of second degree in x and y,</li> <li>● Condition for representing a pair of lines.</li> <li>● Homogenous second-degree equation in x and y.</li> <li>● Angle between pair of lines.</li> <li>● Bisectors of the angles between pair of lines.</li> </ul>	12	<p>3.1 Conic section:</p> <p>Circle:</p> <ul style="list-style-type: none"> <li>● Equation of circle, tangent and normal to a circle, condition of tangency of a line at a point to the circle</li> <li>● Standard equations of parabola, Ellipse and hyperbola.</li> </ul> <p>3.2 Coordinates in space:</p> <ul style="list-style-type: none"> <li>● Coordinate axes and coordinate planes in three dimensions. Coordinates of a point.</li> <li>● Distance between two points and section formula.</li> <li>● Direction cosines and direction ratios of a line joining two points.</li> </ul>	12
4	Vectors	<p>4.1 Product of vectors:</p> <ul style="list-style-type: none"> <li>● Scalar product of two vectors, angle between two vectors,</li> <li>● Geometric interpretation of scalar product,</li> <li>● Properties of scalar product,</li> </ul>	8	<p>4.1 Product of Vectors:</p> <ul style="list-style-type: none"> <li>● Vector product of two vectors, geometrical interpretation of vector product, properties of vector product,</li> </ul>	8

5	Statistics and Probability	<p>5.1 Measure of Dispersion:</p> <ul style="list-style-type: none"> <li>● Range</li> <li>● Quartile deviation, coefficient of QD</li> <li>● Mean deviation</li> </ul> <p>5.2 Probability</p> <ul style="list-style-type: none"> <li>● Random experiment, Sample space and events</li> <li>● Definition of probability: Empirical and mathematical definition of probability</li> <li>● Addition and multiplication laws of probability (independent case only)</li> </ul>	12	<p>5.1 Measure of Dispersion:</p> <ul style="list-style-type: none"> <li>● Standard deviation, variance, coefficient of variation,</li> <li>● Skewness (Karl Pearson, Bowley)</li> </ul> <p>5.2 Probability:</p> <ul style="list-style-type: none"> <li>● Dependent cases, conditional probability (without proof), binomial distribution, mean and standard deviation of binomial distribution (without proof).</li> <li>● Conditional Probability with Bayes theorem (statement only)</li> </ul>	12
6	Calculus	<p>6.1 Limit and continuity:</p> <ul style="list-style-type: none"> <li>● Limit of a function.</li> <li>● Rules of finding limits</li> <li>● Algebraic properties of limits (without proof),</li> <li>● Basic theorems on limits,</li> <li>● Algebraic, trigonometric, exponential and logarithmic</li> </ul>	28	<p>6.1 Derivatives:</p> <ul style="list-style-type: none"> <li>● Derivative of inverse trigonometric, exponential and logarithmic function by definition, differentiating hyperbolic function</li> </ul> <p>6.2 Applications of derivatives: Increasing/ decreasing functions, tangents</p>	28

	<p>functions,</p> <ul style="list-style-type: none"> <li>● Continuity of a function,</li> <li>● Types of discontinuity, graphs of discontinuous function.</li> </ul> <p>6.2 Derivatives:</p> <ul style="list-style-type: none"> <li>● Derivative of a function as rate of change</li> <li>● Derivatives of algebraic, trigonometric, exponential and logarithmic functions by definition (simple forms),</li> <li>● Rules of differentiation.</li> <li>● Second order derivative</li> </ul> <p>6.3 Anti-derivatives:</p> <ul style="list-style-type: none"> <li>● Anti-derivative. integration using basic integrals, integration by substitution and by parts,</li> <li>● the definite integral and its use to find an area under the given curve,</li> <li>● Area between two curves.</li> </ul>		<p>and normal, maxima and minima</p> <p>6.3 Anti-derivatives:</p> <ul style="list-style-type: none"> <li>● Anti-derivatives, standard integrals, integrals reducible to standard forms, integrals of rational function.</li> </ul> <p>6.4 Differential equations:</p> <ul style="list-style-type: none"> <li>● Differential equation and its order, degree</li> <li>● Differential equations of first order and first degree, differential equations with separable variables, homogenous, linear and exact differential equations.</li> </ul>	
	Total	<b>96</b>		<b>96</b>

*\*School must allocate separate classes for practical and project activities for students.*

## 5. Sample project works/practical work for grade 11

Sample project works/mathematical activities for grade 11

1. Prepare the model of types of function by using rubber band and nail in wooden panel.
2. Write two simple statements related to mathematics and write four compound statements by using them.
3. Prepare a model to illustrate the values of sine function and cosine function for different angles which are multiples of  $\pi$  and  $\pi$ .
4. Draw the graph of  $\sin^{-1}x$ , using the graph of  $\sin x$  and demonstrate the concept of mirror reflection (about the line  $y = x$ ).
5. Prepare the model of straight lines in slope intercept, double intercept and normal form.
6. Verify that the equation of a line passing through the point of intersection of two lines  $a_1x + b_1y = 0$  and  $a_2x + b_2y = 0$  is of the form  $(a_1x + b_1y) + K(a_2x + b_2y) = 0$ .
7. Prepare a model and verify that the diagonals of rhombus bisect each other at right angles by using vector method.
8. Geometrically interpret the scalar product of two vectors.
9. Collect the scores of grade 10 students in mathematics and English from your school.
  - a. Make separate frequency distribution with class size 10.
  - b. Which subject has more uniform/consistent result? find it by using quartile deviation.
  - c. Make the group report and present.
10. Roll two dices simultaneously 20 times and list all outcomes. Write the events that the sum of numbers on the top of both dice is a) even b) odd in all above list. Examine either they are mutually exclusive or not. Also find the probabilities of both events.
11. Verify the geometrical significance of derivative.
  1. Find the area of circular region around your school using integration.

## Sample project works/mathematical activities for grade 12

1. Represent the binomial theorem of power 1, 2, and 3 separately by using concrete materials and generalize it with n dimension relating with Pascal's triangle.
2. Prepare a model to explore the principal value of the function  $\sin^{-1}x$  using a unit circle and present in the classroom.

3. Verify the sine law by taking particular triangle in four quadrants.
4. Take a circular object. Find its centre, radius and end points of a diameter using graph paper. Find the equation of that circle.
5. Prepare a concrete material to show parabola by using thread and nail in wooden panel.
6. Construct an ellipse using a rectangle.
7. Fix a point on the middle of the ceiling of your classroom. Find the distance between that point and four corners of the floor.
8. Express the area of triangle and parallelogram in terms of vector.
9. Verify geometrically that:  $\times (+) = \times + \times$
10. Collect the students enrollment of past 5 years of two different technical school of your local community.

(i) Find standard deviation.

(ii) Which school has uniform enrollment? Find

(iii) Find skewness and show it in diagram.

11. Take 4 white and 6 yellow balls of the same shape and size in a bag I. Similarly, take 3 white and 5 yellow balls of the same shape and size in the bag II. Now, draw one ball randomly from one of the bags and note down which ball you have drawn. Then, find the probability that it was drawn from the bag I.
12. Find, how many people will be there after 5 years in your local area by using the concept of differentiation.
13. Verify that the integration is the reverse process of differentiation with examples and curves.

## 6. Learning Facilitation Method and Process

Teacher has to emphasis on the active learning process and on the creative solution of the exercise included in the textbook rather than teacher centered method while teaching mathematics. Students need to be encouraged to use the skills and knowledge related to mathematics in their house, neighborhood, school and daily activities. Teacher has to analyze and diagnose the weakness of the students and create appropriate learning environment to solve mathematical problems in the process of teaching learning.

The emphasis should be given to use diverse methods and techniques for learning facilitation. However, the focus should be given to those method and techniques that promotestudents'

active participation in the learning process. The following are some of the teaching methods that can be used to develop mathematical competencies of the students:

- Inductive and deductive method
- Problem solving method
- Case study
- Project work method
- Question answer and discussion method
- Discovery method/ use of ICT
- Co-operative learning

## 7. Student Assessment

Evaluation is an integral part of learning process. Both formative and summative evaluation system will be used to evaluate the learning of the students. Students should be evaluated to assess the learning achievements of the students. There are two basic purposes of evaluating students in Mathematics: first, to provide regular feedback to the students and bringing improvement in student learning-the formative purpose; and second, to identify student's learning levels for decision making.

### a. Internal Examination/Assessment

Internal assessment includes classroom participation, terminal examinations, and project work/practical work (computer works and lab work) and presentation. The scores of evaluation will be used for providing feedback and to improve their learning. Individual and group works are assigned as projects.

The basis of internal assessment is as follows:

<b>Classroom participation</b>	<b>Marks from terminal examinations</b>	<b>project work/practical work</b>	<b>Total</b>
3	6	16	25

#### (i) Classroom participation

Marks for classroom participation is 3 which is given on the basis of attendance and participation of students in activities in each grade.

#### (ii) Marks from trimester examinations

Marks from each trimester examination will be converted into full marks 3 and calculated

total marks of two trimester in each grade.

**(iii) Project work/practical work**

Each Student should do at least one project work/practical work from each of six content areas and also be required to give a 15 minutes presentation for each project work and practical work in classroom. These project works/practical works will be documented in a file and will be submitted at the time of practical evaluation. Out of six projects/practical works from each area any one project work/practical work should be presented at the time of practical evaluation by student.

**a. External Examination/Evaluation**

External evaluation of the students will be based on the written examination at the end of each grade. It carries 75 percent of the total weightage. The types and number questions will be as per the test specification chart developed by the Curriculum Development Centre.

### Specification Grid

Grade: 11 and 12

Subject: Mathematics

Time: 3 hrs.

SN	Content Area	Working hour (Th.)	Competency level																Area-wise Marks	Number of Questions						
			Knowledge				Understanding				Application				Higher Ability											
			MCQ		SAQ		MCQ		SAQ		LAQ		MCQ		SAQ		LAQ									
			No. of Questions	Marks																						
1	Algebra	18	2	2	2	10	5	5	1	5	1	8	2	2	4	20	1	8	2	2	1	5	1	8	20	MCQ: 2 SAQ: 2 LAQ: 1
2	Trigonometry	9																							9	MCQ: 5
3	Analytic Geometry	9																							9	SAQ: 4 LAQ: 1
4	Vector	6																							6	
5	Statistics & Probability	9																							9	
6	Calculus	21																							22	MCQ: 4 SAQ: 2 LAQ: 1
<b>Total Marks</b>		72	12				18				30				15				75	MCQ: 11 SAQ: 8 LAQ: 3						

Question format plan								
S.N.	Types of Questions	Marks per question	Number of questions				Total number of questions	Total Marks
			Knowledge	Understanding	Application	Higher Ability		
1.	Multiple Choice Question	1	2	5	2	2	11	11
2.	Short Answer Question	5	2	1	4	1	8	40
3.	Long Answer Question	8	0	1	1	1	3	24
<b>Grand Total</b>		<b>14</b>	<b>4</b>	<b>7</b>	<b>7</b>	<b>4</b>	<b>22</b>	<b>75</b>

**Note:**

- Appropriate extra time will be provided for the handicapped students.
- Questions should be prepared by giving the context and one question may have more than one sub-questions.
- Application and higher ability questions can be made by relating the other content areas.
- Questions should be made by addressing all the sub-areas of content.

*At least one multiple choice question should be asked from each area.*

**Technical and Vocational Stream**  
**Secondary Education Curriculum**  
**Chemistry**

**Grade: 11 and 12**

**Credit hour : 3**

**Annual Working hour: 96**

**1. Introduction**

This curriculum is of grade 11 and 12 chemistry. This is designed to provide students with general understanding of the fundamental scientific laws and principles that govern the scientific phenomena in the world. It focuses to develop scientific knowledge, skills, and attitudes required at secondary level (grade 11 and 12) irrespective of what they do beyond this level, as envisioned by national goals. Understanding of scientific concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

This curriculum aims: to provide sufficient knowledge and skills to recognize the usefulness and limitations of laws and principles of chemistry, to develop science related attitudes such as concern for safety and efficiency, concern for accuracy and precision, objectivity, spirit of enquiry, inventiveness, appreciation of ethno-science, and willingness to use technology for effective communication, to provide opportunity for the learners who have deeper interest in the subject to delve into the more advanced contents so that the study of chemistry becomes enjoyable and satisfying to all.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project-work activities, learning facilitation process and assessment strategies so as to enhance the learning of the subject systematically.

**2. Level-wise competencies**

The expected competencies of this course are to:

1. Apply appropriate principles, concepts, theories, laws, models and patterns to interpret the findings, draw conclusion, make generalization, and to predict from chemical facts, observation and experimental data.

2. Correlate old principles, concepts, theories, laws, tools, techniques; to the modern, sustainable and cost-effective skills, tools and techniques in the development of scientific attitude.
3. Apply the principles and methods of science to develop the scientific skill in an industrial process to produce various chemicals in small as well as in industrial scale that are useful in our daily life and in the service of mankind.
4. Explain the social, economic, environmental and other implications of chemistry and appreciate the advancement of chemistry and its applications as essential for the growth of national economy.
5. Describe chemistry as a coherent and developing framework of knowledge based on fundamental theories of the structure and process of the physical world.
6. Perform skills in safe handling of chemicals, taking into account of their physical and chemical properties, risk, environmental hazards, etc.
7. Conduct either a research work or an innovative work in an academic year, under the guidance of teacher, using the knowledge and skills learnt.

### 3. Grade-wise learning Outcomes

Grade 11	Grade 12
<b>Content Area: General and Physical Chemistry</b>	
<p><b>1. Foundation and Fundamentals</b></p> <p>1.1 Recognize the importance and scope of chemistry.</p> <p>1.2 Explain the terms atom, molecule, radicals, valency, molecular formula and empirical formula.</p> <p>1.3 Calculate percentage composition of constituent elements from molecular formula.</p> <p>1.4 Define and use the terms relative atomic mass, relative molecular mass and relative formula mass.</p>	<p><b>1. Volumetric Analysis</b></p> <p>1.1 Define and explain the terms volumetric and gravimetric analysis.</p> <p>1.2 Express the concentration of solutions in terms of percentage, g/l, molarity, molality, normality, ppm, ppb</p> <p>1.3 Define and calculate the equivalent weight of (elements, acids, bases, salts, oxidizing and reducing agents).</p> <p>1.4 Law of equivalence and normality equation and their application for chemical calculation.</p> <p>1.5 Define and explain primary and secondary standard substance.</p> <p>1.6 Explain different types of titration and their applications. (related numerical problems)</p>
<p><b>2. Stoichiometry</b></p> <p>2.1 Explain Dalton's atomic theory and its postulates.</p> <p>2.2 State and explain laws of stoichiometry (law of conservation of mass, law of constant proportion, law of multiple proportion, law of reciprocal proportion and law of gaseous volume).</p>	<p><b>2. Ionic Equilibrium</b></p> <p>2.1 Explain the limitations of Arrhenius concepts of acids and bases.</p> <p>2.2 Define Bronsted and Lowry concepts for acids and bases.</p> <p>2.3 Define conjugate acids and conjugate base.</p> <p>2.4 Identify conjugate acid-base pairs of Bronsted acid and base.</p> <p>2.5 Define and explain Lewis acids and bases.</p> <p>2.6 Explain ionization constant of water and calculate pH and pOH in aqueous medium using <math>K_w</math> values.</p> <p>2.7 Solubility and solubility product principle.</p> <p>2.8 Show understanding of the common ion effect.</p>

<p>2.3 Explain Avogadro's hypothesis and deduce some relationships among molecular mass with vapour density, volume of gas and number of particles.</p> <p>2.4 Define mole and explain its relation with mass, volume and number of particles.(mole concept related numerical problems)</p>	<p>2.9 Describe the application of solubility product principle and common ion effect in precipitation reactions.</p> <p>2.10 Define a Buffer solution and show with equations how a Buffer system works.</p> <p>2.11 Define and differentiate different types of salts (simple salts, complex salt, acidic salts, basic salts and neutral salts).</p>
<p><b>3. Atomic Structure</b></p> <p>3.1 Explain Rutherford atomic model and its limitations.</p> <p>3.2 Summarize Bohr's atomic theory; its importance and limitations.</p> <p>3.3 Explain the origin of hydrogen spectra with the help of Bohr's model.</p> <p>3.4 Explain quantum numbers.</p> <p>3.5 Explain the concept and general shapes of s and p orbitals.</p> <p>3.6 Use Aufbau principle, Pauli Exclusion Principle and Hund's rule to write the electronic configuration of the atoms and ions.</p>	<p><b>3. Chemical Kinetics</b></p> <p>3.1 Define chemical kinetics.</p> <p>3.2 Explain and use the terms rate of reaction, rate equation, rate constant.</p> <p>3.3 Explain qualitatively factors affecting rate of reaction.</p> <p>3.4 Derive and explain integrated rate equation and half life for zero, and first order reaction.</p> <p>3.5 Explain the significance of Arrhenius equation and solve the related problems.</p> <p>3.6 Solve related numerical problems based on rate, rate constant and order of zero and first order reactions.</p>
<p><b>4. Classification of elements and Periodic Table</b></p> <p>4.1 Explain modern periodic table and its features.</p>	<p><b>4. Thermodynamics</b></p> <p>4.1 Define thermodynamics.</p> <p>4.2 Explain the energy change in chemical reactions.</p> <p>4.3 Define the terms internal energy and state function.</p>

<p>4.2 Classify the elements of periodic table in different blocks and groups.</p> <p>4.3 Define the term nuclear charge and effective nuclear charge.</p> <p>4.4 Explain and interpret the Periodic trend of atomic radii, ionic radii, ionization energy, electronegativity, electron affinity and metallic characters of elements.</p>	<p>4.4 State and explain first law of thermodynamics.</p> <p>4.5 State and explain enthalpy and enthalpy changes in various process (enthalpy of solution, enthalpy of formation enthalpy of combustion and enthalpy of reaction).</p> <p>4.6 Explain endothermic and exothermic process with the help of energy profile diagram.</p> <p>4.7 State Hess's law of constant heat summation (thermo-chemistry) and solve numerical problems related to Hess's law.</p> <p>4.8 Define the term entropy and spontaneity.</p> <p>4.9 State and explain second law of thermodynamics.</p> <p>4.10 Define standard Gibbs free energy change of reaction by means of the equation <math>\Delta G = \Delta H - T\Delta S</math>.</p> <p>4.11 State whether a reaction or process will be spontaneous by using the sign of <math>\Delta G</math>.</p> <p>4.12 Explain the relationship between <math>\Delta G</math> and equilibrium constant.</p>
---	---

<p><b>5. Chemical Bonding and Shapes of Molecules</b></p> <p>5.1 Valence shell, valence electron and octet rule</p> <p>5.2 Explain the ionic bond and the properties of ionic compounds.</p> <p>5.3 Explain the covalent bond, co-ordinate bond and the properties of covalent compound.</p> <p>5.4 Describe the co-ordinate covalent compounds with some examples.</p> <p>5.5 Lewis dot system for structure of compound.</p>	<p><b>5. Electrochemistry</b></p> <p>5.1 Electrode potential and standard electrode potential</p> <p>5.2 Types of electrodes: Standard hydrogen electrode and calomel electrodes</p>
--	--

<p>5.6 Write the lewis dot diagrams of some ionic and covalent compounds (NaCl, MgCl<sub>2</sub>, NH<sub>4</sub>Cl, Oxides of Hydrogen, Nitrogen and Phosphorous, common mineral acids).</p> <p>5.7 Write the resonance structure of some covalent species.</p> <p>5.8 Use VSEPR theory to describe the shapes of simple covalent molecules(BeF<sub>2</sub>, BF<sub>3</sub>, CH<sub>4</sub>, H<sub>2</sub>O, NH<sub>3</sub>, CO<sub>2</sub>, PCI<sub>5</sub> etc).</p> <p>5.9 Describe the concept of hybridization in simple covalent molecules.</p>	<p>5.3 Define electrochemical series and its application</p> <p>5.4 Voltaic cell: Zn-Cu cell, Ag-Cu cell</p> <p>5.5 Cell potential and standard cell potential</p>
<p><b>6. Oxidation and Reduction</b></p> <p>6.1 Define oxidation and reduction in terms of electronic concept.</p> <p>6.2 Define oxidation number and explain the rules of assigning oxidation number.</p> <p>6.3 Calculate oxidation numbers of elements in compounds and ions.</p> <p>6.4 Explain redox reaction, oxidizing and reducing agent.</p> <p>6.5 Balance the given redox reaction by oxidation number method or ion electron method (half equation method).</p> <p>6.6 Explain the qualitative and quantitative aspects of faradays laws of electrolysis.</p>	-
<p><b>7. States of Matter</b></p> <p>7.1 List the postulates of kinetic molecular theory.</p> <p>7.2 State and explain Gas laws, related equations and related numerical problems.</p> <p>7.3 Explain Boyle's law, Charle's law, Avogadro law, combined gas law, Daltons law, Graham's law</p> <p>7.4 State and use the general gas equation <math>PV = nRT</math> in calculations.</p> <p>7.5 Explain the meaning of Universal gas constant and its significance.</p> <p>7.6 Distinguish between real gas and ideal gas.</p>	

<p>7.7 Deviation of real gas from ideality (solving related numerical problems based on gas laws).</p> <p>7.8 Explain the physical properties of liquid like Evaporation and condensation, vapour pressure and boiling, surface tension and viscosity in terms of intermolecular force and intermolecular space.</p> <p>7.9 Describe Liquid crystals and their applications.</p> <p>7.10 Differentiate between amorphous and crystalline solids.</p> <p>7.11 Define unit cell, crystal lattice, efflorescence, deliquescence, hygroscopy, water of crystallization with examples.</p>	-
---	---

### Content Area: Inorganic Chemistry

<p><b>8. Chemistry of Non-metals</b></p> <p>8.1 Describe and compare the chemistry of atomic and nascent hydrogen.</p> <p>8.2 Explain isotopes of hydrogen and their uses, application of hydrogen as fuel, heavy water and its applications.</p> <p>8.3 Allotropes of oxygen</p> <p>8.4 Explain types of oxides (acidic, basic, neutral, amphoteric, peroxide and mixed oxides).</p> <p>8.5 Describe occurrence, preparation (from oxygen), structure and test of ozone.</p> <p>8.6 Describe ozone layer depletion (causes, effects and control measures) and uses of ozone.</p> <p>8.7 Give reason for inertness of nitrogen and active nitrogen.</p> <p>8.8 Give chemical properties of ammonia [Action with air(O<sub>2</sub>), CuSO<sub>4</sub> solution, water, FeCl<sub>3</sub> solution, Conc. HCl, Mercurous nitrate paper,] and uses.</p>	<p><b>6. Chemistry of Metals</b></p> <p>6.1 Define metallurgy and its types (hydrometallurgy, pyrometallurgy, and electrometallurgy).</p> <p>6.2 Define ores, gangue or matrix, flux and slag, alloy and amalgam.</p> <p>6.3 Explain general principles of extraction of metals (different processes involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite and electrochemical reduction, refining of metals (poling and electro-refinement).</p>
---	---

<p>8.9 Explain the chemical properties of nitric acid [HNO<sub>3</sub>] as an acid and oxidizing agent (action with zinc, magnesium, iron, copper, sulphur, carbon, SO<sub>2</sub> and H<sub>2</sub>S) and uses.</p> <p>8.10 Ring test for determination of nitrate ion (NO<sub>3</sub><sup>-</sup>).</p> <p>8.11 Explain general characteristics of halogens.</p> <p>8.12 Compare the methods of preparation of halogens without diagram and description.</p> <p>8.13 Explain allotropes of carbon (crystalline and amorphous) including fullerenes (structure, general properties and uses).</p> <p>8.14 Allotropes of sulphur and their uses.</p> <p>8.15 Prepare hydrogen sulphide gas by using Kipp's apparatus.</p> <p>8.16 Explain its properties (Acidic nature, reducing nature, analytical reagent) and uses of hydrogen sulphide.</p>	
<p><b>9. Chemistry of Metals</b></p> <p>9.1 Give general characteristics of alkali metals.</p> <p>9.2 State and explain extraction of sodium from Down's process.</p> <p>9.3 Describe properties of sodium (action with Oxygen, water, acids nonmetals and ammonia) and uses.</p> <p>9.4 Explain properties and uses of sodium hydroxide (precipitation reaction and action with carbon monoxide).</p> <p>9.5 State and explain properties and uses of sodium carbonate (action with CO<sub>2</sub>, SO<sub>2</sub>, water, precipitation reactions).</p> <p>9.6 Give general characteristics of alkaline earth metals.</p>	<p><b>7. Studies of Heavy Metals</b></p> <p>7.1 Explain occurrence and extraction of copper, iron and zinc metals</p> <p>7.2 Explain chemistry (preparation, properties and uses) of blue vitriol.</p> <p>7.3 Write molecular formula and uses of red and black oxide of copper.</p> <p>7.4 Describe properties (with air, acid, alkali, displacement reaction) and uses of zinc.</p>

9.7 Write molecular formula and uses of (quick lime, bleaching powder, magnesia plaster of paris and epsom salt).	7.5 Explain chemistry (preparation, properties and uses) of white vitriol.
9.8 Explain solubility of hydroxides, carbonates and sulphates of alkaline earth metals.	7.6 Explain properties and uses of iron.
9.9 Explain stability of carbonate and nitrate of alkaline earth metals.	7.7 Explain manufacture of steel by basic oxygen method and Open-Hearth process.
	7.8 Explain corrosion of iron and its prevention.

### Content Area: Organic Chemistry

<b>10. Basic concept of organic chemistry</b>	<b>8. Haloalkanes</b>
10.1 Define organic chemistry and organic compounds.	8.1 Describe briefly the nomenclature, isomerism and classification of monohaloalkanes.
10.2 Explain tetra-covalency and catenation property of carbon.	8.2 Show the preparation of monohaloalkanes from alkanes, alkenes and alcohols.
10.3 Describe classification of organic compounds.	8.3 Describe elimination reaction (dehydrohalogenation-Saytzeff's rule), Reduction reactions, Wurtz reaction.
10.4 Define functional groups and homologous series with examples.	8.4 Show the preparation of trichloromethane from ethanol and propanone.
10.5 State and explain the structural formula, contracted formula and bond line structural formula.	8.5 Explain the chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid, propanone, and aqueous alkali.
10.6 Introduce preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number and gasoline additive.	

<p><b>11: Fundamental principles</b></p> <p>11.1 State IUPAC name of the organic compounds.</p> <p>11.2 Detect N, S and halogens(X) in organic compounds by Lassaigne's test.</p> <p>11.3 Define and classify isomerism in organic compounds (structure isomerism, types of structure isomerism: chain isomerism, position, isomerism, functional isomerism, metamerism and tautomerism).</p>	<p><b>9. Alcohols</b></p> <p>9.1 Describe briefly the nomenclature, isomerism and classification of monohydric alcohol.</p> <p>9.2 Show the preparation of monohydric alcohols from Haloalkane, primary amines and esters.</p> <p>9.3 Define absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit; and alcoholic beverage.</p>
<p><b>12. Hydrocarbons</b></p> <p>12.1 Define and describe saturated and unsaturated hydrocarbons (alkane alkene and alkyne).</p> <p>12.2 Show preparation of alkanes from haloalkanes (Reduction and Wurtz reaction), Decarboxylation, Catalytic hydrogenation of alkene and alkyne.</p> <p>12.3 Explain chemical properties of alkanes: substitution reactions (halogenation, nitration, and sulphonation only)</p> <p>12.4 Explain chemical properties of alkenes, i.e. addition reaction with HX (Markovnikov's addition and peroxide effect), H<sub>2</sub>O, O<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub> only.</p> <p>12.5 Describe chemical properties of alkynes, i.e. addition reaction with (H<sub>2</sub>, HX, H<sub>2</sub>O), acidic nature (action with Sodium, ammoniacal AgNO<sub>3</sub> and ammoniacal Cu<sub>2</sub>Cl<sub>2</sub>).</p>	<p><b>10. Phenols</b></p> <p>10.1 Describe briefly the nomenclature of phenol.</p> <p>10.2 Show the preparation of phenol from chlorobenzene, Diazonium salt and benzene sulphonic acid</p> <p>10.3 State physical properties of phenol.</p> <p>10.4 State important uses of phenol.</p>

<p><b>13. Aromatic Hydrocarbons</b></p> <p>13.1 Define aromatic compounds and their characteristics.</p> <p>13.2 State and explain Huckel's rule, Kekule structure of benzene, resonance and isomerism.</p> <p>13.3 Show the preparation of benzene from: decarboxylation of sodium benzoate, phenol, ethyne and chlorobenzene.</p> <p>13.4 Explain physical and chemical properties of benzene (Addition reaction: hydrogen, halogen and ozone, Electrophilic substitution reactions: orientation of benzene derivatives (o, m &amp; p), nitration, sulphonation, halogenation Friedal-Craft's alkylation and acylation, combustion of benzene) and uses.</p>	<p><b>11. Aldehydes and Ketones</b></p> <p>11.1 Describe briefly the nomenclature and isomerism of aliphatic aldehydes and ketones.</p> <p>11.2 Show the preparation of aldehydes and ketones from dehydrogenation, oxidation of alcohol, ozonolysis of alkenes, acid chloride, gem dihaloalkane and catalytic hydration of alkynes</p> <p>11.3 State physical properties and uses of aldehydes and ketones.</p> <p>11.4 Distinguish between aliphatic aldehydes and ketones by using 2,4- DNP reagent, Tollen's reagent and Fehling's solution.</p> <p>11.5 Define formalin and state its uses.</p>
--	--

<b>Content Area: Applied Chemistry</b>	
<p><b>14. Modern Chemical Manufactures</b></p> <p>14.1 State and show manufacture of ammonia by Haber's process (principle and flow-sheet diagram).</p> <p>14.2 State and show manufacture of nitric acid by Ostwald's process (principle and flow-sheet diagram).</p> <p>14.3 Fertilizers (types of chemical fertilizers and production of urea with flow-sheet diagram)</p>	<p><b>12. Chemistry in the Service of Mankind</b></p> <p>12.1 Explain addition and condensation polymers.</p> <p>12.2 Explain elastomers and fibres.</p> <p>12.3 Describe natural and synthetic polymers.</p> <p>12.4 Explain some synthetic polymers (polythene, PVC, Teflon, polystyrene, nylon and bakelite).</p> <p>12.5 Describe characteristics of drugs.</p> <p>12.6 Differentiate natural and synthetic drugs.</p>

	<p>12.7 Classify some common drugs.</p> <p>12.8 Be aware of adverse effect of drug addiction.</p> <p>12.9 Explain insecticides, herbicides and fungicides.</p>
	<p><b>13. Nuclear Chemistry and Applications of Radioactivity</b></p> <p>13.1 Describe natural and artificial radioactivity.</p> <p>13.2 Units of radioactivity.</p> <p>13.3 Explain nuclear reactions.</p> <p>13.4 Distinguish between nuclear fission and fusion reactions.</p> <p>13.5 Describe nuclear power and nuclear weapons.</p> <p>13.6 Explain industrial uses of radioactivity.</p> <p>13.7 State the medical uses of radioactivity.</p> <p>13.8 Explain radiocarbon dating.</p> <p>13.9 Describe harmful effects of nuclear radiations.</p>

#### 4. Scope and Sequence of Contents (Theory)

Grade 11	TH	Grade 12	TH
<b>Content Area: General and Physical Chemistry</b>			
<p><b>1. Foundation and Fundamentals</b></p> <p>1.1 General introduction of chemistry</p> <p>1.2 Importance and scope of chemistry</p> <p>1.3 Basic concepts of chemistry (atoms, molecules, relative masses of atoms and</p>	<b>2</b>	<p><b>1. Volumetric Analysis</b></p> <p>1.1 Introduction to gravimetric analysis, volumetric analysis and equivalent weight</p> <p>1.2 Relationship between equivalent weight, atomic weight and valency</p>	<b>8</b>

<p>molecules, atomic mass unit (amu), radicals, molecular formula, empirical formula )</p> <p>1.4 Percentage composition from molecular formula</p>		<p>1.3 Equivalent weight of compounds (acid, base, salt, oxidizing and reducing agents)</p> <p>1.4 Concentration of solution and its units in terms of: Percentage, g/L, molarity, molality, normality and formality, ppm and ppb</p> <p>1.5 Primary and secondary standard substances</p> <p>1.6 Law of equivalence and normality equation</p> <p>1.7 Titration and its types: Acid-base titration, redox titration (related numerical problems)</p>	
<p><b>2. Stoichiometry</b></p> <p>2.1 Dalton's atomic theory and its postulates</p> <p>2.2 Laws of stoichiometry</p> <p>2.3 Avogadro's law and some deductions</p> <p>2.3.1 Molecular mass and vapour density</p> <p>2.3.2 Molecular mass and volume of gas</p> <p>2.3.3 Molecular mass and no. of particles</p> <p>2.4 Mole and its relation with mass, volume and number of particles</p> <p>2.5 Calculations based on mole concept</p>	<p><b>5</b></p>	<p><b>2. Ionic Equilibrium</b></p> <p><b>Introduction to Acids and Bases</b></p> <p>2.1 Limitation of Arrhenius concepts of acids and bases</p> <p>2.2 Bronsted –Lowry definition of acids and bases</p> <p>2.3 Relative strength of acids and bases</p> <p>2.4 Conjugate acid –base pairs</p> <p>2.5 Lewis definition of acids and bases</p> <p>2.6 pH value: pH of strong and weak acids, pH of strong and weak bases</p> <p>2.7 Solubility and solubility product principle</p> <p>2.8 Common Ion effect</p> <p>2.9 Application of solubility product principle and common ion effect in precipitation reactions</p>	<p><b>8</b></p>

		2.10 Buffer solution and its application 2.11 Types of salts: Acidic salts, basic salts, simple salts, complex salts (introduction and examples)	
<b>3. Atomic Structure</b> 3.3 Postulates of Bohr's atomic model and its application 3.4 Spectrum of hydrogen atom 3.5 Defects of Bohr's theory 3.6 Quantum Numbers 3.7 Orbitals and shape of s and p orbitals only 3.8 Aufbau Principle 3.9 Pauli's exclusion principle 3.10 Hund's rule and electronic configurations of atoms and ions (up to atomic no. 30)	<b>5</b>	<b>3. Chemical Kinetics</b> 3.1 Introduction to chemical kinetics 3.2 Rate of reactions: Average and instantaneous rate of reactions 3.3 Rate law and its expressions 3.4 Rate constant and its unit and significance 3.5 Half-life of zero and first order reactions 3.6 Activation energy 3.7 Factors affecting rate of reactions: Effect of concentration, temperature (Arrhenius Equation) and effect of catalyst (energy profile diagram) 3.9 Related numerical problems	<b>6</b>
<b>4. Classification of elements and Periodic Table</b> 4.1 Modern periodic law and modern periodic table - classification of elements into different groups, periods and blocks 4.2 Nuclear charge and effective nuclear charge 4.3 Periodic trend and periodicity	<b>4</b>	<b>4. Thermodynamics</b> 4.1 Introduction to thermodynamics 4.2 Energy in chemical reactions 4.3 Internal energy 4.4 First law of thermodynamics 4.5 Enthalpy and enthalpy changes: Endothermic and exothermic processes)	<b>8</b>

<p>4.3.1 Atomic radii</p> <p>4.3.2 Ionic radii</p> <p>4.3.3 Ionization energy</p> <p>4.3.4 Electron affinity</p> <p>4.3.5 Electronegativity</p> <p>4.3.6 Metallic characters (General trend and explanation only)</p>		<p>4.6 Enthalpy of reaction, enthalpy of solution, enthalpy of formation, enthalpy of combustion</p> <p>4.7 Hess's law of thermochemistry</p> <p>4.8 Entropy and spontaneity</p> <p>4.9 Second law of thermodynamics</p> <p>4.10 Gibbs' free energy and prediction of spontaneity</p> <p>4.11 Relationship between <math>\Delta G</math> and equilibrium constant (Solving related numerical problems)</p>	
<p><b>5. Chemical Bonding and Shapes of Molecules</b></p> <p>5.1 Valence shell, valence electron and octet theory</p> <p>5.2 Ionic bond and its properties</p> <p>5.3 Covalent bond and coordinate covalent bond</p> <p>5.4 Properties of covalent compounds</p> <p>5.5 Lewis dot structure of some common compounds of s and p block elements</p> <p>5.6 Resonance</p> <p>5.7 VSEPR theory and shapes of some simple molecules (<math>\text{BeF}_2</math>, <math>\text{BF}_3</math>, <math>\text{CH}_4</math>, <math>\text{CH}_3\text{Cl}</math>, <math>\text{PCl}_5</math>, <math>\text{SF}_6</math>, <math>\text{H}_2\text{O}</math>, <math>\text{NH}_3</math>, <math>\text{CO}_2</math>, <math>\text{H}_2\text{S}</math>, <math>\text{PH}_3</math>)</p> <p>5.8 Hybridization involving s and p orbitals only</p>	<b>5</b>	<p><b>5. Electrochemistry</b></p> <p>5.1 Electrode potential and standard electrode potential</p> <p>5.2 Types of electrodes: Standard hydrogen electrode and calomel electrodes</p> <p>5.3 Electrochemical series and its applications</p> <p>5.4 Voltaic cell: Zn-Cu cell, Ag- Cu cell</p> <p>5.5 Cell potential and standard cell potential</p>	<b>5</b>

<p><b>6. Oxidation and Reduction</b></p> <p>6.1 General and electronic concept of oxidation and reduction</p> <p>6.2 Oxidation number and rules for assigning oxidation number</p> <p>6.3 Balancing redox reactions by oxidation number and ion-electron (half reaction) method</p> <p>6.4 Electrolysis</p> <p>6.4.1 Qualitative aspect</p> <p>6.4.2 Quantitative aspect (Faradays laws of electrolysis)</p>	<b>5</b>	-	
<p><b>7. States of Matter</b></p> <p><b>7.1 Gaseous state</b></p> <p>7.1.1 Kinetic theory of gas and its postulates</p> <p>7.1.2 Gas laws</p> <p>7.1.2.1 Boyle's law and Charles' law</p> <p>7.1.2.2 Avogadro's law</p> <p>7.1.2.3 Combined gas equation</p> <p>7.1.2.4 Dalton's law of partial pressure</p> <p>7.1.2.5 Graham's law of diffusion</p> <p>7.1.3 Ideal gas and ideal gas equation</p>			

<p>7.1.4 Universal gas constant and its significance</p> <p>7.1.5 Deviation of real gas from ideality (Solving related numerical problems based on gas laws)</p> <p><b>7.2 Liquid state</b></p> <p>7.2.1 Physical properties of liquids</p> <p>7.2.1.1 Evaporation and condensation</p> <p>7.2.1.2 Vapour pressure and boiling point</p> <p>7.2.2 Liquid crystals and their applications</p> <p><b>7.3 Solid state</b></p> <p>7.3.2 Amorphous and crystalline solids</p> <p>7.3.3 Efflorescent, Deliquescent and Hygroscopic solids</p> <p>7.3.4 Crystallization and crystal growth</p> <p>7.3.5 Water of crystallization</p>	<b>6</b>	-	
---	----------	---	--

<b>Content Area: Inorganic Chemistry</b>			
<p><b>8. Chemistry of Non-metals</b></p> <p><b>8.1 Hydrogen</b></p> <p>8.1.1 Chemistry of atomic and nascent hydrogen</p> <p>8.1.2 Isotopes of hydrogen and their uses</p> <p>8.1.3 Application of hydrogen as fuel</p> <p>8.1.4 Heavy water and its applications</p>		<p><b>6. Chemistry of Metals</b></p> <p><b>6.1 Metals and Metallurgical Principles</b></p> <p>6.1.1 Definition of metallurgy and its types (hydrometallurgy, pyrometallurgy, electrometallurgy)</p> <p>6.1.2 Introduction of ores</p> <p>6.1.3 Gangue or matrix, flux and slag, alloy and amalgam</p>	

<p><b>8.2 Allotropes of Oxygen</b></p> <p>8.2.1 Definition of allotropy and examples</p> <p>8.2.2 Oxygen: Types of oxides (acidic, basic, neutral, amphoteric, peroxide and mixed oxides)</p> <p><b>8.3 Ozone</b></p> <p>8.3.1 Occurrence</p> <p>8.3.2 Preparation of ozone from oxygen</p> <p>8.3.3 Structure of ozone</p> <p>8.3.4 Test for ozone</p> <p>8.3.5 Ozone layer depletion (causes, effects and control measures)</p> <p>8.3.6 Uses of ozone</p>	<b>3</b>	<p>6.1.4 General principles of extraction of metals (different processes involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite and electrochemical reduction</p> <p>6.1.5 Refining of metals (poling and electro-refinement)</p>	<b>5</b>
<p><b>8.4 Nitrogen</b></p> <p>8.4.1 Reason for inertness of nitrogen and active nitrogen</p> <p>8.4.2 Chemical properties of ammonia [ Action with <math>\text{CuSO}_4</math> solution, water, <math>\text{FeCl}_3</math> solution, Conc. <math>\text{HCl}</math>, Mercurous nitrate paper, <math>\text{O}_2</math> ]</p> <p>8.4.3 Uses and harmful effects of ammonia</p> <p>8.4.6 Chemical properties of nitric acid [<math>\text{HNO}_3</math> as an acid and oxidizing agent (action with zinc,</p>	<b>4</b>	<p><b>7. Studies of Heavy Metals</b></p> <p><b>7.1 Copper</b></p> <p>7.1.1 Occurrence and extraction of copper from copper pyrite</p> <p>7.1.2 Properties (with air, acids, aqueous ammonia and metal ions) and uses of copper</p> <p>7.1.3 Chemistry (preparation, properties and uses) of blue vitriol</p> <p>7.1.4 Other compounds of copper (red oxide and black oxide of copper) formula and uses only</p>	<b>10</b>

<p>magnesium, iron, copper, sulphur, carbon, SO<sub>2</sub> and H<sub>2</sub>S)</p> <p>8.4.7 Ring test for nitrate ion</p>		<p><b>7.2 Zinc</b></p> <p>7.2.1 Occurrence and extraction of zinc from zinc blende</p> <p>7.2.2 Properties (with air, acid, alkali, displacement reaction) and uses of zinc</p> <p>7.2.3 Chemistry (preparation, properties and uses) of white vitriol</p>	
<p><b>8.5 Halogens</b></p> <p>8.5.1 General characteristics of halogens</p> <p>8.5.2 Comparative study on preparation (no diagram and description is required),</p>	<b>2</b>	<p><b>7.4 Iron</b></p> <p>7.4.1 Occurrence and extraction of iron</p> <p>7.4.2 Properties and uses of iron</p> <p>7.4.3 Manufacture of steel by Basic Oxygen Method and Open Hearth Process</p> <p>7.4.4 Corrosion of iron and its prevention</p>	
<p><b>8.6 Carbon</b></p> <p>8.6.1 Allotropes of carbon (crystalline and amorphous) including fullerenes (structure, general properties and uses only)</p>	<b>1</b>		
<p><b>8.7 Sulphur</b></p> <p>8.7.1 Allotropes of sulphur (name only) and uses of sulphur</p> <p>8.7.2 Hydrogen sulphide (preparation from Kipp's apparatus with diagram,) properties (Acidic nature, reducing nature, analytical reagent) and uses</p>	<b>2</b>		
<p><b>9.1 Alkali Metals</b></p> <p>9.1.1 General characteristics of alkali metals</p> <p>9.1.2 Sodium [extraction from Down's process,</p>	<b>5</b>		

<p>properties (action with Oxygen, water, acids nonmetals and ammonia) and uses]</p> <p>9.1.3 Properties (precipitation reaction and action with carbon monooxide) and uses of sodium hydroxide</p> <p>9.1.4 Properties (action with CO<sub>2</sub>, SO<sub>2</sub>, water, precipitation reactions) and uses of sodium carbonate</p> <p><b>9.2 Alkaline Earth Metals</b></p> <p>9.2.1 General characteristics of alkaline earth metals</p> <p>9.2.2 Molecular formula and uses of (quick lime, bleaching powder, magnesia, plaster of paris and epsom salt)</p> <p>9.2.3 Solubility of hydroxides, carbonates and sulphates of alkaline earth metals (general trend with explanation)</p> <p>9.2.4 Stability of carbonate and nitrate of alkaline earth metals (general trend with explanation)</p>		-
--	--	---

**Content Area: Organic Chemistry**

<b>10. Basic Concept of Organic Chemistry</b>	<b>6</b>	<b>8. Haloalkanes</b>	<b>4</b>
10.1 Introduction to organic chemistry and organic compounds		<b>8.1 Introduction</b>	
10.2 Tetra-covalency and catenation properties of carbon		8.2 Nomenclature, isomerism and classification of monohaloalkanes	
10.3 Classification of organic compounds		8.3 Preparation of monohaloalkanes from alkanes, alkenes and alcohols	
10.4 Alkyl groups, functional groups and homologous series		8.4 Physical properties of monohaloalkanes	
10.5 Idea of structural formula, contracted formula and bond line structural formula		8.5 Preparation of trichloromethane from ethanol and propanone	
10.6 Preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number and gasoline additive		8.6 Chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid, propanone, and aqueous alkali	
<b>11. Fundamental Principles of Organic Chemistry</b>	<b>4</b>	<b>9. Alcohols</b>	<b>3</b>
11.1 IUPAC Nomenclature of Organic Compounds (upto chain having 6-carbon atoms)		9.1 Introduction	
11.2 Qualitative analysis of organic compounds (detection of N, S and halogens by Lassaigne's test)		9.2 Nomenclature, isomerism and classification of monohydric alcohol	
11.3 Isomerism in Organic Compounds		9.3 Preparation of monohydric alcohols from Haloalkane, primary amines, and esters	
11.4 Definition and classification of isomerism		9.4 Definition of common terms: Absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit; alcoholic beverage	

11.5 Structural isomerism and its types: chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism			
<b>12. Saturated and unsaturated Hydrocarbons</b> 12.1 Classification of hydrocarbon (alkane, alkene, alkyne) 12.2 Preparation of alkane from haloalkanes (Reduction and Wurtz reaction), from Decarboxylation, from Catalytic hydrogenation of alkene and alkyne. 12.3 Chemical properties of alkanes: substitution reactions (halogenation, nitration, and sulphonation only) 12.4 Chemical properties of alkenes: Addition reaction with HX (Markovnikov's addition and peroxide effect), H <sub>2</sub> O, O <sub>3</sub> , H <sub>2</sub> SO <sub>4</sub> only 12.5 Chemical properties: Addition reaction with (H <sub>2</sub> , HX, H <sub>2</sub> O), Acidic nature (action with Sodium, ammoniacal AgNO <sub>3</sub> and ammoniacal Cu <sub>2</sub> Cl <sub>2</sub> )	4	<b>10. Phenols</b> 10.1 Introduction and nomenclature 10.2 Preparation of phenol from i. chlorobenzene ii. Diazonium salt and iii. benzene sulphonic acid 10.3 Physical properties and uses of phenol	2
<b>13. Aromatic Hydrocarbons</b> 13.1 Introduction and characteristics of aromatic compounds		<b>11 Aliphatic aldehydes and ketones</b> 11.1 Introduction, nomenclature and isomerism 11.2 Preparation of aldehydes and ketones from:	

<p>13.2 Huckel's rule of aromaticity</p> <p>13.3 Kekule structure of benzene</p> <p>13.4 Resonance and isomerism</p> <p>13.5 Preparation of benzene from decarboxylation of sodium benzoate, phenol, and ethyne only</p> <p>13.6 Physical properties of benzene</p> <p>13.7 Chemical properties of benzene: Addition reaction: hydrogen, halogen, Electrophilic substitution reactions: orientation of benzene derivatives (o, m &amp; p), nitration, sulphonation, halogenations, Friedal-Craft's reaction (alkylation and acylation), combustion of benzene (free combustion only) and uses</p>	<b>6</b>	<p>Dehydrogenation and oxidation of alcohol, Ozonolysis of alkenes, Acid chloride, Gem dihaloalkane, Catalytic hydration of alkynes, and its uses.</p> <p>11.3 Physical properties of aldehydes and ketones</p> <p>11.4 Distinction between aldehyde and ketones by using 2,4- DNP reagent, Tollen's reagent, Fehling's solution</p> <p>11.5 Formalin and its uses</p>	<b>4</b>
---	----------	--	----------

**Content Area: Applied Chemistry**

<b>Content Area: Applied Chemistry</b>			
<p><b>14. Modern Chemical Manufactures</b></p> <p>14.1 Modern Chemical Manufactures (principle and flow sheet diagram only)</p> <p>14.1.1 Manufacture of ammonia by Haber's process,</p> <p>14.1.2 Manufacture of nitric acid by Ostwald's process,</p>	<b>3</b>	<p><b>12. Chemistry in the service of mankind</b></p> <p><b>12.1 Polymers</b></p> <p>12.1.1 Addition and condensation polymers</p> <p>12.1.2 Elastomers and fibres</p> <p>12.1.3 Natural and synthetic polymers</p> <p>12.1.4 Some synthetic polymers (polythene, PVC, Teflon, polystyrene, nylon and bakelite)</p>	<b>4</b>

14.2 Fertilizers (Chemical fertilizers, types of chemical fertilizers, production of urea with flow-sheet diagram)		<b>12.2 Drugs</b> 12.2.1 Characteristics of drugs 12.2.2 Natural and synthetic drugs 12.2.3 Classification of some common drugs 12.2.4 Habit forming drugs and drug addiction <b>12.3 Pesticides</b> 12.4.1 Introduction to insecticides, herbicides and fungicides	
		<b>13. Nuclear Chemistry and Applications of Radioactivity</b> 13.1 Natural and artificial radioactivity 13.2 Units of radioactivity 13.3 Nuclear reactions 13.4 Nuclear fission and fusion reactions 13.5 Nuclear power and nuclear weapons 13.6 Industrial uses of radioactivity 13.7 Medical uses of radioactivity 13.8 Radiocarbon dating 13.9 Harmful effects of nuclear radiations	<b>5</b>
<b>Total</b>	<b>72</b>		<b>72</b>

## 5. Practical Portion (24 Teaching hours)

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency of the curriculum as well as reinforcing their learning of the theoretical subject content. This part of the curriculum focuses more on skill development than knowledge building. Students must spend lots of time for working with chemical materials. Observations and investigations can enhance student learning. Project work may consist of activities designed to demonstrate the concepts and ideas through collecting, processing, analyzing and communicating data.

Students should learn to,

- collect and identify
- preserve
- test of chemicals
- draw figure, chart, preparing models, slides etc
- handle the equipment, instruments and laboratory handling with experimentation
- draw conclusion

Students should perform at least 8 experiments, either listed below or designed by teacher, so that no more than three experiments come from the same categories mentioned below.

### a) List of Experiments for grade 11

A. Experiments based on laboratory techniques:

1. To separate the insoluble component in pure and dry state from the given mixture of soluble and insoluble solids (NaCl, sand and camphor).
2. To separate a mixture of two soluble solids by fractional crystallization ( $\text{KNO}_3$  + NaCl).
3. To prepare a saturated solution of impure salt and obtain the pure crystal of the same salt by crystallization.
4. To separate the component of a mixture of two insoluble solids (one being soluble in dil. acids).
5. To obtain pure water from given sample of impure water (Distillation).

B. Experiments to study the different types of reactions (Neutralization, Precipitation, Redox reaction and Electrolysis):

6. To carry out the following chemical reactions, represent them in molecular as

well as ionic forms and write the colour of the products formed:

- a. Ferrous sulphate solution + ammonia solution
  - b. Ferric chloride solution + ammonia solution
  - c. Copper sulphate solution + sodium hydroxide solution (heat the mixture)
  - d. Copper sulphate solution + ammonia solution (add ammonia drop by drop at first and then excess)
  - e. Ferric chloride solution + potassium ferrocyanide solution
  - f. Ferrous sulphate solution + potassium ferricyanide solution
  - g. Copper sulphate solution + potassium iodide solution
  7. To perform precipitation reaction of  $\text{BaCl}_2$  and  $\text{H}_2\text{SO}_4$  and obtain solid  $\text{BaSO}_4$ .
  8. To neutralize sodium hydroxide with hydrochloric acid solution and recover the crystal of sodium chloride.
  9. To test the ferrous ions in the given aqueous solution and oxidize it to ferric ion, (Ferrous and Ferric ion) (Redox Reaction)
  10. To study the process of electrolysis and electroplating.
- C. Experiments on quantitative analysis:
11. To determine the weight of given piece of Mg by hydrogen displacement method.
  12. To determine the solubility of the given soluble solid at laboratory temperature.
- D. Experiments on preparation of gas and study of properties:
13. To prepare and collect hydrogen gas and study the following properties;
    - a. Solubility with water, colour, odour;
    - b. Litmus test;
    - c. Burning match stick test; and
    - d. Reducing properties of nascent hydrogen.
  14. To prepare and collect ammonia gas and investigate the following properties:
    - a. Solubility with water, colour and odour;
    - b. Litmus test;
    - c. Action with copper sulphate solution phenolphthalein solution
    - d. Action with mercurous nitrate paper.

E. Experiments on qualitative analysis:

15. To detect the basic radical of the given salt by dry way and the acid radical by dry and wet ways in its aqueous solution.

Basic radicals:  $Zn^{++}$ ,  $Al^{+++}$ ,  $Mg^{++}$ ,  $Ca^{++}$ ,

Acid radicals:  $CO_3^{-}$ ,  $SO_4^{-}$ ,  $NO_3^{-}$ , Br, I, Cl

16. To detect the presence of  $Cl^-$ ,  $SO_4^{--}$  and  $CO_3^{--}$  in the given sample of tap water and distilled water.

**b) List of Sample project works for grade 11**

1. Observe in your surroundings (kitchen, school, shop, etc.) and make a possible list of organic and inorganic compounds. How are they different? Why is it necessary to study them separately, put your argument?
2. Study of the methods of purification of water.
3. Testing the hardness of drinking water from different sources and the study of cause of hardness.
4. Study of the acidity of different samples of the tea leaves.
5. Preparation of molecular models using stick and clay.
6. Study of adulteration of food materials.
7. Study of application and adverse effects of pesticides on human health.
8. Study of use and adverse effects of plastics on environment.
9. Analysis of soil samples. (elaboration need pH, humus content)
10. Investigation on corrosion and rusting on iron.

Note: Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the syllabus. However, repetition of topic should be discouraged.

**c) List of experiments for grade 12**

A. Experiments based on recovery and preparation of salt

1. To recover blue vitriol crystals from the given mixture of copper sulphate and sodium chloride.
2. To recover  $CaCO_3$  from the mixture of  $CaCO_3$  and  $MgCO_3$  (dolomite).

B. Experiments based on volumetric analysis (Titration)

3. To prepare primary standard solution of  $Na_2CO_3$  and standardize the given

acid solution (HCl) by the standard solution.

4. To determine the strength of approximate NaOH solution with the help of standard decinormal solution of HCl supplied.
5. To determine the strength of bench sulphuric acid (H<sub>2</sub>SO<sub>4</sub>) with the help of standard NaOH or Na<sub>2</sub>CO<sub>3</sub> solution and express the concentration in (i) normality (ii) molarity (iii) gm/litre (iv) percentage (Double titration).
6. To standardize the given approximate KMnO<sub>4</sub> solution with the help of primary standard oxalic solution (Redox titration).

**C. Experiments based on organic chemistry:**

7. To detect foreign elements present in a given organic compounds (N, S and X).
8. To identify the functional group present in the organic compounds (-OH, -CHO, -CO-, -NH<sub>2</sub>, and -COO-)

**D. Experiments based on thermochemistry:**

9. To determine the enthalpy of neutralization of a strong acid and strong base.
10. To determine the molar enthalpy, change of ammonium chloride solution

**E. Experiments based on chemical kinetics:**

11. To study the kinetics of the reaction between sodium thiosulphate and hydrochloric acid.
12. To study the kinetics of the reaction between propanone and iodine

**F. Experiments based on salt analysis:**

13. To perform complete salt analysis to detect the acid and basic radicals present in the given inorganic salt (at least three salt samples).

**G. Experiments based on applied and analytical Chemistry:**

14. To determine the contents of acetic acid in the given volume of vinegar by titrimetric analysis.
15. To prepare some common compounds:
  - a. Potash alum
  - b. Iodoform
  - c. Fehling's solution
  - d. Tollen's reagent
16. To demonstrate the pH value of unknown sample solutions.

#### **d) List of sample project works for grade 12**

1. Observe brick industry/chemical industry/old smoky cooking kitchen/use of chemical fertilizers/use of insecticides/ vehicular smokes, etc. and draw the conclusion of environmental impact of the chemical pollution.
2. Collect different types of plastics (or synthetic polymers) and study the effect of heat on them.
3. Preparation of soap using coconut oil or any vegetable oil.
4. Study of formation of rust in the iron nail in various conditions.
5. Study of the different types of food preservatives used in different food available in the market.
6. Investigation on the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
7. Study the acidic nature of alcohol and phenol.
8. Study the distinction between aliphatic aldehyde, aromatic aldehyde and aliphatic ketone.
9. Study the presence of pesticides residues in fruits and vegetables.

Note: Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the syllabus. However, repetition of topic should be discouraged.

#### **6. Learning Facilitation Process**

Students should be facilitated to learn rather than just accumulation of information. Teacher plays vital role for delivering subject matters although others' role is also important. Student centered teaching-learning process is highly emphasized. Students are supposed to adopt multiple pathway of learning, such as online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study by students is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning is anticipated.

During the delivery process of science teaching in grade 11 and 12, basically following three approaches will be adopted;

<b>Conceptual/Theoretical</b>	<b>Practical/Application/Experimental</b>	<b>Project works</b>
Knowledge of content (fact, terminology, definitions, learning procedures Understanding of content (concept, ideas, theories, principles)	Lab. based practical work science process and equipment handling skills building	Research work (survey and mini research) innovative work or experiential learning connection to theory and application
3.5 credit hrs spent for understanding of content	1 credit hr spent for experiment	0.5 credit hr spent in field work

### a) **Conceptual/Theoretical Approach**

Possible theoretical methods of delivery may include the following;

- a. interaction
- b. question answer
- c. demonstrations
- d. ICT based instructions
- e. cooperative learning
- f. group discussions (satellite learning group, peer group, small and large group)
- g. debate
- h. seminar presentation
- i. Journal publishing
- j. daily assignment

### b) **Practical/Application/Experimental approach**

Practical work is the integral part of the learning science. The process of lab based practical work comprises as;

- a. familiarity with objective of practical work
- b. familiarity with materials, chemicals, apparatus
- c. familiarity with lab process (safety, working modality etc.)
- d. conduction of practical work (systematically following the given instruction)

- e. analysis, interpretation and drawing conclusion

**c) Project work Approach**

Project work is an integral part of the science learning. Students should be involved in project work to foster self-learning of students in the both theoretical and practical contents. Students will complete project work to have practical idea through learning by doing approach and able to connect the theory into the real-world context. It is regarded as method/ process of learning rather than content itself. So use of project work method to facilitate any appropriate contents of this curriculum is highly encouraged.

In this approach student will conduct at least one research work, or an innovative work under the guidance of teacher, using the knowledge and skills learnt. It could include any of the followings;

- (a) Mini research
- (b) Survey
- (c) Model construction
- (d) Paper based work
- (e) Study of ethno-science

General process of research work embraces the following steps;

- a. Understanding the objective of the research
- b. Planning and designing
- c. Collecting information
- d. Analysis and interpretation
- e. Reporting /communicating (presentation, via visual aids, written report, graphical etc.)

General process of innovative work embraces the following steps;

- a. Identification of innovative task (either assigned by teacher or proposed by student)
- b. Planning
- c. Performing the task
- d. Presentation of the work
- e. Record keeping of the work

Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the Curriculum. However, repetition of topic should be discouraged.

### Learning process matrix

<b>Knowledge and understanding</b>	<b>Scientific skills and process</b>	<b>Values, attitudes and application to daily life</b>
<ul style="list-style-type: none"> <li>• Scientific phenomenon, facts, definition, principles, theory, concepts and new discoveries</li> <li>• Scientific vocabulary, glossary and terminology</li> <li>• Scientific tools, devices, instruments apparatus</li> <li>• Techniques of uses of scientific instruments with safety</li> <li>• Scientific and technological applications</li> </ul>	<ul style="list-style-type: none"> <li>• Basic and integrated scientific process skills</li> </ul> <p><b>Process</b></p> <ul style="list-style-type: none"> <li>• Investigation</li> <li>• Creative thinking</li> <li>• problem solving</li> </ul>	<ul style="list-style-type: none"> <li>• Responsible</li> <li>• Spending time for investigation</li> </ul>

### Basic Science Process Skills includes,

1. Observing: Using senses to gather information about an object or event. It is description of what was actually perceived.
2. Measuring: Comparing unknown physical quantity with known quantity (standard unit) of same type.
3. Inferring: Formulating assumptions or possible explanations based upon observations.
4. Classifying: Grouping or ordering objects or events into categories based upon characteristics or defined criteria.
5. Predicting: Guessing the most likely outcome of a future event based upon a pattern of evidence.
6. Communicating: using words, symbols, or graphics to describe an object, action or event.

## **Integrated Science Process Skills includes,**

1. Formulating hypotheses: Determination of the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
2. Identifying of variables: Identification of the changeable factors (independent and dependent variables) that can affect an experiment.
3. Defining variables operationally: explaining how to measure a variable in an experiment.
4. Describing relationships between variables: explaining relationships between variables in an experiment such as between the independent and dependent variables.
5. Designing investigations: designing an experiment by identifying materials and describing appropriate steps in a procedure to test a hypothesis.
6. Experimenting: carrying out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
7. Acquiring data: collecting qualitative and quantitative data as observations and measurements.
8. Organizing data in tables and graphs: presenting collected data in tables and graphs.
9. Analyzing investigations and their data: interpreting data, identifying errors, evaluating the hypothesis, formulating conclusions, and recommending further testing where necessary.
10. Understanding cause and effect relationships: understanding what caused what to happen and why.
11. Formulating models: recognizing patterns in data and making comparisons to familiar objects or ideas.

## **7. Student Assessment**

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc., are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Out of 100 full marks Internal evaluation covers 25 marks. Internal evaluation consists of Practical work (16 marks), (b) Marks from trimester examinations (6 marks), and (c) Classroom participation (3 marks)

- Practical Activities

Practical works and project works should be based on list of activities mentioned in this curriculum or designed by teacher. Mark distribution for practical work and project work will be as follows:

S.N.	Criteria		Elaboration of criteria	Marks
1	Participation		Classroom participation includes attendance (1) and participation in learning (2)	3
2	Practical and Project work	Laboratory experiment	Correctness of apparatus setup/preparation	2
			Observation/Experimentation	2
			Tabulation	1
			Data processing and Analysis	1
			Conclusion (Value of constants or prediction with justification)	1
			Handling of errors/precaution	1
3.		Viva-voce	Understanding of objective of the experiment	1
			Skills of the handling of apparatus in use	1
			Overall impression	1
		Practical work records and attendance	Records (number and quality)	2
		Project work	Reports (background, objective, methodology, finding, conclusion)	2
		Presentation	1	
		Total Practical and project work score	<b>19</b>	
3	Trimester Exam		First and second trimester's score (3+3)	<b>6</b>
<b>Total</b>				<b>25</b>

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of laboratory experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

- **Marks from trimester examinations**

Total of 6 marks, 3 marks from each trimester.

- **Classroom participation (3 marks)**

Classroom participation includes attendance (1) and participation in learning (2).

**(b) External Evaluation**

Out of 100 marks theoretical evaluation covers 75 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade :11

Subject : Chemistry

Time: 3 hrs.

S.N.	Area	Working hour	Competency level				Area wise Score
			Knowledge/ Remembering	Understanding	Applying	Higher Ability	
1	Physical chemistry	32	MCQ (2x1) SQ (2x5)	MCQ (5 x1) SQ (1x5) LQ (1x8)	MCQ (3x1) SQ (2x5) LQ (1x8)	MCQ (1x1) SQ (3x5) LQ (1x8)	33
2	Inorganic chemistry	17					18
3	Organic chemistry	20					21
4	Applied chemistry	3					3
<b>Total</b>		<b>72</b>	<b>12</b>	<b>18</b>	<b>21</b>	<b>24</b>	<b>75</b>

## Item format plan

S.N.	Type of item	Score per item	Number of items				Total item	Total Score
1	Multiple Choice Questions	1	2	5	3	1	11	11
2	Short Question Answer	5	2	1	2	3	8	40
3	Long Question Answer	8	0	1	1	1	3	24
<b>Grand Total</b>			<b>4</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>22</b>	<b>75</b>

Grade : 12

S.N.	Area	Working hour	Competency level				Area wise Score
			Knowledge/ Remembering	Understanding	Applying	Higher Ability	
1	Physical chemistry	35	MCQ (2x1) SQ (2x5)	MCQ (5 x1) SQ (1x5) LQ (1x8)	MCQ (3x1) SQ (2x5) LQ (1x8)	MCQ (1x1) SQ (3x5) LQ (1x8)	36
2	Inorganic chemistry	15					16
3	Organic chemistry	13					14
4	Applied chemistry	9					9
<b>Total</b>		<b>72</b>	<b>12</b>	<b>18</b>	<b>21</b>	<b>24</b>	<b>75</b>

Item format plan								
S.N.	Type of item	Score per item	Number of items				Total item	Total Score
1	Multiple Choice Questions	1	2	5	3	1	11	11
2	Short Question Answer	5	2	1	2	3	8	40
3	Long Question Answer	8	0	1	1	1	3	24
<b>Grand Total</b>			4	7	6	5	22	75

### Remarks:

- Item format in composite should be met as per the specification grid.
- +2 marks variation will be allowed within the area. But cannot be nil.
- In case of 5 or 8 marks items, these should ensure that 1 mark will be assigned per element expected as correct response. However, cognitive behavior intended might not be single behavior within the item. But in total cognitive distribution should met.  $\pm 2$  marks variation will be allowed within the cognitive levels.
- SQ and LQ can be structured (have two or more sub-items). SQ and LQ can be distributed to two or more cognitive behaviors. In such case these will be added to their respective cognitive behavior. In sum the distribution of cognitive behavior should be approximately to the required distribution.
- The distribution of questions based on cognitive domain will be nearby 15% knowledge/remembering, 25% understanding, 30% applying and 30% higher ability level.
- In case of short question there will be 2"OR" questions and in case of long question there will be 1 "OR" question.

**Technical and Vocational Stream**  
**Secondary Education Curriculum**  
**Physics**

**Grade: 11 and 12**

**Credit hour: 3**

**Annual Working hour: 96**

**1. Introduction**

This curriculum presumes that the students joining grade 11 and 12 science stream come with diverse aspirations, some may continue to higher level studies in specific areas of science, others may join technical and vocational areas or even other streams. The curriculum is designed to provide students with general understanding of the fundamental scientific laws and principles that govern the scientific phenomena in the world. It focuses to develop scientific knowledge, skill competences and attitudes required at secondary level (grade 11-12) irrespective of what they do beyond this level, as envisioned by national goals. Understanding of scientific concepts and their application, in day to day context as well as the process of obtaining new knowledge through holistic approach of learning in the spirit of national qualification framework is emphasized in the curriculum.

In particular, this curriculum aims to provide sufficient knowledge and understanding of science for all learners to become confident citizens in the technological world. It helps the students to recognize the usefulness and limitations of laws and principles of physics and use them in solving problems encountered in their daily lives along a sound foundation for students who wish to study physics or related professional or vocational courses in higher education. It also helps to develop science related attitudes such as a concern for safety and efficiency, concern for accuracy and precision, objectivity, a spirit of enquiry, inventiveness, appreciation of ethno-science, and willingness to use technology for effective communication. It also promotes awareness of the principles and laws of science that are often the result of cumulative efforts and their studies and applications are subject to economic and technological limitations and social, cultural and ethical perceptions/acceptance.

The curriculum prepared in accordance with National Curriculum Framework is structured for two academic years in such a way that it incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the

learning on the subject systematically.

## **2. Level-wise competencies**

In completion of this course, students are expected to demonstrate the following competencies:

1. Relate the phenomena and processes of the world around them to the knowledge and understanding of physical laws, principles and theories and describe them using appropriate scientific vocabulary, terminology and conventions
2. Use scientific instruments, apparatus and methods to collect, evaluate and communicate information accurately and precisely
3. Design simple experiment to develop relations among physical quantities,
4. Carry out simple scientific research on issues related to physics and
5. Construct simple models to illustrate physical concepts
6. Use the knowledge of physics to promote care for the environment, indigenous knowledge, social values and ethics.

## 3. Grade wise learning Outcomes

Grade 11	Grade 12
<b>Content Area: Mechanics</b>	
<p><b>1. Physical Quantities</b></p> <p>1.1 Demonstrate the meaning, importance and applications of precision in the measurements</p> <p>1.2 Understand the meaning and importance of significant figures in measurements</p> <p>1.3 Explain the meaning of dimensions of a physical quantity</p> <p>1.4 Apply dimensional analysis method to check the homogeneity of physical equations</p>	<p><b>1. Rotational dynamics</b></p> <p>1.1 Recall equations of angular motion and compare them with equations of linear motion</p> <p>1.2 Derive the expression for rotational kinetic energy</p> <p>1.3 Describe the term moment of inertia and radius of gyration</p> <p>1.4 Find the moment of inertia of thin uniform rod rotating about its center and its one end</p> <p>1.5 Describe the work and power in rotational motion with expression</p> <p>1.6 Define angular momentum and prove the principle of conservation of angular momentum</p> <p>1.7 Solve numerical problems and conceptual questions regarding the rotational dynamics</p>
<p><b>2. Vectors</b></p> <p>2.1 Distinguish between scalar and vector quantities</p> <p>2.2 Add or subtract coplanar vectors by drawing scale diagram (vector triangle, parallelogram or polygon method)</p> <p>2.3 Describe scalar and vector products</p> <p>2.4 Understand the meaning and applications of scalar</p>	<p><b>2. Periodic motion</b></p> <p>2.1 Define simple harmonic motion and state its equation.</p> <p>2.2 Derive the expressions for energy in simple harmonic motion</p> <p>2.3 Derive the expression for period for vertical oscillation of a mass suspended from coiled spring</p> <p>2.4 Derive expression for period of simple pendulum</p>

and vector product with examples	2.5	Solve the numerical problems and conceptual questions regarding the periodic motion
2.5 Solve related problems.		
<b>3. Kinematics</b>	<b>3. Fluid statics</b>	
3.1 Explain and use the concept of relative velocity	3.1	Define up-thrust, pressure in fluid, buoyancy, center of buoyancy and meta center
3.2 Establish equations for a uniformly accelerated motion in a straight line from graphical representation of such motion and use them to solve related numerical problems	3.2	Describe surface tension and explain its principle
3.3 Write the equations of motion under the action of gravity and solve numerical problem related to it	3.3	State Stoke's law and use it to determine the coefficient of viscosity of given liquid
3.4 Understand projectile motion as motion due to a uniform velocity in one direction and a uniform acceleration in a perpendicular direction, derive the equations for various physical quantities (maximum height, time of flight, time taken to reach maximum height, horizontal range, resultant velocity) and use them to solve mathematical problems related to projectile motion	3.4	Solve the numerical problems and conceptual questions regarding the fluid statics
<b>4. Dynamics:</b>		-
4.1 Define linear momentum, impulse, and establish the relation between them		
4.2 Define and use force as rate of change of momentum		
4.3 State and prove the principle of conservation of linear momentum using Newton's second and Newton's third of motion		

<p>4.4 Define and apply moment of a force and torque of a couple</p> <p>4.5 Solve the numerical problem and conceptual question on dynamics</p>	
<p><b>5. Work, energy and power:</b></p> <p>5.1 Explain work done by a constant force and a variable force</p> <p>5.2 State and prove work-energy theorem</p> <p>5.3 State and prove the principle of conservation of energy</p> <p>5.4 Differentiate between conservative and non-conservative force</p> <p>5.5 Solve the numerical problems and conceptual questions regarding work, energy, power and collision</p>	-
<p><b>6. Circular motion</b></p> <p>6.1 Define angular displacement, angular velocity and angular acceleration</p> <p>6.2 Establish the relation between angular and linear velocity &amp; acceleration</p> <p>6.3 Define centripetal force and centripetal acceleration</p> <p>6.4 Solve the numerical problem</p>	-
<p><b>7. Gravitation</b></p> <p>7.1 Explain Newton's law of gravitation</p> <p>7.2 Define gravitational field strength</p>	

<p>7.3 Define and derive formula of gravitational potential and gravitational potential energy</p> <p>7.4 Define escape velocity and derive the expression of escape velocity</p> <p>7.5 Define and derive the expression for orbital velocity and time period of a satellite</p> <p>7.6 Solve the numerical problem</p>	-
<p><b>8. Elasticity</b></p> <p>8.1 State and explain Hooke's law</p> <p>8.2 Define the terms stress, strain, elasticity and plasticity</p> <p>8.3 Define the types of elastic modulus such as young modulus, bulk modulus and shear modulus</p> <p>8.4 Derive the expression for energy stored in a stretched wire</p> <p>8.5 Solve the numerical problems and conceptual questions regarding elasticity</p>	-

<b>Content Area: Heat and thermodynamics</b>	
<p><b>9. Heat and temperature</b></p> <p>9.1 Explain the molecular concept of thermal energy, heat and temperature, and cause and direction of heat flow</p> <p>9.2 Explain the meaning of thermal equilibrium and Zeroth law of thermodynamics.</p>	<p><b>4. First Law of Thermodynamics</b></p> <p>4.1 Clarify the concept of thermodynamic system.</p> <p>4.2 Explain the meaning of work done by the system and work done on the system, and describe how work done by gas during expansion can be calculated from indicator (P – V) diagram.</p>

	4.3 Define and explain two specific heat capacities of gas appreciating the relation $C_p - C_v = R$ and $c_p - c_v = r$ .
<p><b>10. Thermal Expansion</b></p> <p>10.1 Explain some examples and applications of thermal expansion, and demonstrate it with simple experiments.</p> <p>10.2 Explain linear, superficial, cubical expansion and define their corresponding coefficients with physical meaning.</p> <p>10.3 Establish a relation between coefficients of thermal expansion.</p> <p>10.4 Explain real and apparent expansion of liquid appreciating the relation <math>\gamma_r = \gamma_g + \gamma_a</math>.</p> <p>10.5 Solve mathematical problems related to thermal expansion.</p>	
<p><b>11. Quantity of Heat</b></p> <p>11.1 Define heat capacity and specific heat capacity and explain application of high specific heat capacity of water and low specific heat capacity of cooking oil and massage oil</p> <p>11.2 Describe Newton's law of cooling with some suitable daily life examples.</p> <p>11.3 Explain the meaning of latent heat of substance appreciating the graph between heat and temperature and define specific latent heat of fusion and vaporization.</p>	-

<p>11.4 Distinguish evaporation and boiling.</p> <p>11.5 Define triple point.</p> <p>11.6 Solve mathematical problems related to heat</p>	
<p><b>12. Rate of heat flow</b></p> <p>12.1 Explain the transfer of heat by conduction, convection and radiation with examples and state their applications in daily life.</p> <p>12.2 Define temperature gradient and relate it with rate of heat transfer along a conductor.</p> <p>12.3 Explain ideal radiator (<math>e=1</math>, <math>a=1</math>) and black body radiation.</p> <p>12.4 State and explain Stefan's law of black body radiation using terms; emissive power and emissivity.</p> <p>12.5 Solve mathematical problems related to thermal conduction and black body radiations.</p>	-

<b>Content Area : Wave and Optics</b>	
<p><b>13. Reflection at curved mirrors</b></p> <p>13.1 State the relation between object distance, image distance and focal length of curved mirrors</p> <p>13.2 State the relation between object size and image size</p> <p>13.3 Calculate the focal length of curved mirrors and its applications</p>	<p><b>5. Wave motion</b></p> <p>5.1 Define and understand progressive wave</p> <p>5.2 Write progressive wave in mathematical form</p> <p>5.3 Discuss the condition under which stationary waves can be formed</p> <p>5.4 Write stationary wave in mathematical form</p> <p>5.5 Calculate frequency, amplitude, velocity, time period etc of progressive wave</p>

<p><b>14. Refraction at plane surfaces</b></p> <p>14.1 Recall the laws of refraction</p> <p>14.2 Understand the meaning of lateral shift</p>	<p><b>6. Mechanical waves</b></p> <p>6.1 Calculate Speed of wave motion</p> <p>6.2 Describe Velocity of sound in gas</p> <p>6.3 Describe Laplace correction</p> <p>6.4 Formulate the effect of temperature, pressure, humidity on velocity of sound and their physical meaning</p>
<p><b>15. Refraction through prisms:</b></p> <p>15.1 Understand minimum deviation condition</p> <p>15.2 Discuss relation between angle of prism, angle of minimum deviation and refractive index</p> <p>15.3 Understand deviation in small angle prism and learn its importance in real life</p>	<p><b>7. Wave in pipes and strings</b></p> <p>7.1 Understand the formation of stationery waves in closed and open pipes</p> <p>7.2 Define and understand harmonics and overtones</p> <p>7.3 State and use the formula for velocity of transverse waves along a stretched string</p>
<p><b>16. Lenses</b></p> <p>16.1 State properties of Spherical lenses</p> <p>16.2 State the relation between object distance, image distance and focal length of a convex lens</p> <p>16.3 Define visual angle and angular magnification</p> <p>16.4 Derive Lens maker's formula and use it to find focal length</p>	<p><b>8. Acoustic phenomena:</b></p> <p>8.1 Describe sound waves as pressure waves in a medium</p> <p>8.2 Characterize the sound using its intensity, loudness, quality and pitch</p> <p>8.3 Discuss Doppler's effect</p> <p>8.4 Apply Doppler effect in realistic case where source and observers are in relative motion.</p>
<p><b>17. Dispersion</b></p> <p>17.1 Understand pure spectrum</p> <p>17.2 Discuss chromatic and spherical aberration</p> <p>17.3 Discuss achromatism in lens and its applications</p>	

-	<p><b>9. Interference</b></p> <p>9.1 Explain the Phenomenon of Interferences</p> <p>9.2 Understand the meaning of coherent sources</p> <p>9.3 Describe Young's double slit experiment and obtain the expression for nth order maxima</p> <p><b>Diffraction</b></p> <p>9.4 Describe diffraction at single slit</p> <p>9.5 Understand diffraction pattern of image</p> <p>9.6 Explain diffraction through diffraction grating</p> <p>9.7 Explain the resolving power of optical instrument</p> <p><b>Polarization</b></p> <p>9.8 Describe phenomenon of polarization</p> <p>9.9 Polaroids and their applications.</p> <p>9.10 State and use Brewster's law</p>
---	--

<b>Content Area: Electricity and Magnetism</b>	
<p><b>18. Electric charges</b></p> <p>18.1 Understand the concept of electric charge and charge carriers</p> <p>18.2 Understand the process of charging by friction and use the concept to explain related day to day observations</p> <p>18.3 Understand that, for any point outside a spherical conductor, the charge on the sphere may be considered to act as a point</p>	<p><b>10. Electrical circuits</b></p> <p>10.1 Understand Kirchhoff's law and use to calculate unknown parameters in electrical circuits</p> <p>10.2 Describe the circuit diagram of Wheatstone bridge circuit and its Importance</p> <p>10.3 Describe meter bridge and understand it</p>

<p>charge at its centre</p> <p>18.4 State Coulomb's law</p> <p>18.5 Compute the magnitude and direction of the net force acting at a point due to multiple charges</p>	<p>10.5 Know construction, working and importance of potentiometer</p> <p>10.6 Distinguish between perfect conductors and superconductors</p> <p>10.7 learn the technique to convert galvanometer into voltmeter and ammeter</p>
<p><b>19. Electric field:</b></p> <p>19.1 Describe an electric field as a region in which an electric charge experiences a force</p> <p>19.2 Define electric field strength as force per unit positive charge acting on a stationary point charge</p> <p>19.3 Calculate forces on charges in uniform electric fields of known strength</p> <p>19.4 Use strength of a point charge in free space or air</p> <p>19.5 Understand the concept of electric flux of a surface</p> <p>19.6 State Gauss law and apply it for a field of a charged sphere and for line charge</p>	<p><b>11. Magnetic properties of materials:</b></p> <p>11.1 Define relative permeability and relative susceptibility of a magnetic material</p> <p>11.2 Discuss relationship between relative permeability and susceptibility</p> <p>11.3 Discuss Hysteresis of ferromagnetism</p> <p>11.4 Understand Dia,-para- and ferro-magnetic materials</p>
<p><b>20. Potential, potential difference and potential energy</b></p> <p>20.1 Define potential at a point as the work done per unit positive charge in bringing a small test charge from infinity to the point</p> <p>20.2 Use electron volt as a unit of electric potential energy</p> <p>20.3 Recall and use for the potential in the field of a point charge</p>	<p><b>12. Magnetic field</b></p> <p>12.1 Show understanding of the concept of magnetic field lines and magnetic flux and sketch magnetic field lines around a straight current carrying conductor and long solenoid</p> <p>12.2 Explain Oersted's experiment, its outcome and limitations</p> <p>12.3 Discuss force on moving charge in uniform magnetic field</p>

	<p>12.4 Discuss force on a current carrying conductor placed in uniform magnetic field</p> <p>12.5 Describe moving coil galvanometer and know its applications</p> <p>12.6 Explain Hall effect and derive the expression <math>V_H = BI/ntq</math> where <math>t</math> is thickness</p> <p>12.7 State Biot and Savart law and know its application on (i) a circular coil (ii) a long straight conductor (iii) a long solenoid</p>
<p><b>21. Capacitor</b></p> <p><b>21.1 capacitance and capacitor</b></p> <p>a. Show understanding of the uses of capacitors in simple electrical circuits</p> <p>b. Define capacitance as the ratio of the change in an electric charge in a system to the corresponding change in its electric potential and associate it to the ability of a system to store charge</p> <p>c. Use</p> <p><b>21.2 Parallel plate capacitor</b></p> <p>a. Derive, using Gauss law and for parallel plate capacitor</p> <p>b. Explain the effect on the capacitance of parallel plate capacitor of changing the surface area and separation of the plates</p>	<p><b>13. Alternating Currents:</b></p> <p>13.1 Understand peak and rms value of AC current and voltage</p> <p>13.2 Discuss AC through a resistor, a capacitor and an inductor</p> <p>13.3 Understand Phasor diagram in RC and RL circuits</p> <p>13.4 Describe series resonance condition and know its applications</p> <p>13.5 Understand the meaning of quality factor</p> <p>13.6 Discuss power in AC circuits and know the term power factor</p> <p>13.7 Solve the numerical problems.</p>

**21.3 Combination of capacitors**

- a. Derive formula for combined capacitance for capacitors in parallel combinations
- b. Solve problems related to capacitors in parallel combinations

**22. DC Circuits****22.1 Electric Currents; Drift velocity and its relation with current**

- a. Understand the concept that potential difference between two points in a conductor makes the charge carriers drift
- b. Define electric current as the rate of flow of positive charge,  
 $Q = It$
- c. Derive, using  $Q=It$  and the definition of average drift velocity, the expression  $I=nAVd$  where  $n$  is the number density of free charge carriers

**22.2 Ohm's law Ohm's law; Electrical Resistance: resistivity and conductivity**

- a. Define and apply electric resistance as the ratio of potential difference to current
- b. Define *ohm*, *resistivity* and *conductivity*
- c. Use  $R = \rho l / A$  for a conductor
- d. Explain, using  $R = \rho l / A$ , how changes in dimensions of a conducting wire works as a variable resistor

**22.3 Current-voltage relations: ohmic and non-ohmic**

- a. Sketch and discuss the I–V characteristics of a metallic conductor at constant temperature, a semiconductor diode and a filament lamp d) state Ohm’s law
- b. State Ohm’s law and identify ohmic and non-ohmic resistors

**22.4 Resistances in series and parallel**

- a. Derive, using laws of conservation of charge and conservation of energy, a formula for the combined resistance of two or more resistors in parallel
- b. Solve problems using the formula for the combined resistance of two or more resistors in series

**22.5 Potential divider**

- a. Understand the principle of a potential divider circuit as a source of variable p.d. and use it in simple circuits
- b. Explain the use of sensors (thermistors, light-dependent resistors and strain gauges) in potential divider circuit as a source of potential difference that is dependent on temperature, illumination and strain respectively

**22.6 Electromotive force of a source, internal resistance**

- a. Define electromotive force (e.m.f.) in terms of the energy transferred by a source in driving unit charge round a complete circuit
- b. Distinguish between e.m.f. and potential difference (p.d.) in terms of energy considerations

c. Understand the effects of the internal resistance of a source of e.m.f. on the terminal potential difference

**Content Area: Modern Physics**

**23. Nuclear physics**

- 23.1 Explain how nucleus was discovered
- 23.2 Convey the meaning of mass number, atomic number
- 23.3 Calculate the expression of nuclear density
- 23.4 Explain the existence of different isotopes of the same element
- 23.5 Describe main theme of Einstein's mass energy relation and state the relation
- 23.6 Explain the meaning of mass defect and cause of it
- 23.7 Describe the terms creation and annihilation
- 23.8 Derive the relation of binding energy and binding energy per unit nucleon of different nuclei
- 23.9 Plot a graph between BE per nucleon and mass number of different nuclei
- 23.10 Define nuclear fusion and fission and explain the mechanism of energy release
- 23.11 Solve numerical problems related to nuclear physics

**14. Electrons**

- 14.1 Describe Millikan's oil drop experiment and explain how it suggests quantization of charge
- 14.2 Describe the motion of electrons in electric and magnetic fields and derive appropriate mathematical expressions
- 14.3 Describe J.J Thomson's experiment with suitable diagrams to explain the discovery of electron and its characters
- 14.4 Solve numerical problems related to above topics

**Content Area: Electricity and Magnetism**

<p><b>18. Electric charges</b></p> <p>1.1 Understand the concept of electric charge and charge carriers</p> <p>1.2 Understand the process of charging by friction and use the concept to explain related day to day observations</p> <p>1.3 Understand that, for any point outside a spherical conductor, the charge on the sphere may be considered to act as a point charge at its centre</p> <p>1.4 State Coulomb's law</p> <p>1.5 Compute the magnitude and direction of the net force acting at a point due to multiple charges</p>	<p><b>10. Electrical circuits</b></p> <p>10.1 Understand Kirchoff's law and use to calculate unknown parameters in electrical circuits</p> <p>10.2 Describe the circuit diagram of Wheatstone bridge circuit and its Importance</p> <p>10.4 Describe meter bridge and understand it</p> <p>10.5 Know construction, working and importance of potentiometer</p> <p>10.6 Distinguish between perfect conductors and super conductors</p> <p>10.7 learn the technique to convert galvanometer into voltmeter and ammeter</p>
<p><b>19. Electric field:</b></p> <p>1.1 Describe an electric field as a region in which an electric charge experiences a force</p> <p>1.2 Define electric field strength as force per unit positive charge acting on a stationary point charge</p> <p>1.3 Calculate forces on charges in uniform electric fields of known strength</p> <p>1.4 Use strength of a point charge in free space or air</p> <p>1.5 Understand the concept of electric flux of a surface</p> <p>1.6 State Gauss law and apply it for a field of a charged sphere and for line charge</p>	<p><b>11. Magnetic properties of materials:</b></p> <p>11.1 Define relative permeability and relative susceptibility of a magnetic material</p> <p>1.2 Discuss relationship between relative permeability and susceptibility</p> <p>11.3 Discuss Hysteresis of ferromagnetism</p> <p>11.4 Understand Dia,-para- and ferro-magnetic materials</p>

<p><b>20. Potential, potential difference and potential energy</b></p> <p>1.1 Define potential at a point as the work done per unit positive charge in bringing a small test charge from infinity to the point</p> <p>1.2 Use electron volt as a unit of electric potential energy</p> <p>1.3 Recall and use for the potential in the field of a point charge</p>	<p><b>12. Magnetic field</b></p> <p>1.1 Show understanding of the concept of magnetic field lines and magnetic flux and sketch magnetic field lines around a straight current carrying conductor and long solenoid</p> <p>1.2 Explain Oersted's experiment, its outcome and limitations</p> <p>1.3 Discuss force on moving charge in uniform magnetic field</p> <p>1.4 Discuss force on a current carrying conductor placed in uniform magnetic field</p>
	<p>1.5 Describe moving coil galvanometer and know its applications</p> <p>1.6 Explain Hall effect and derive the expression <math>V_H = BI/ntq</math> where t is thickness</p> <p>1.7 State Biot and Savart law and know its application on (i) a circular coil (ii) a long straight conductor (iii) a long solenoid</p>

<p><b>21. Capacitor</b></p> <p><b>21.1 capacitance and capacitor</b></p> <p>a. Show understanding of the uses of capacitors in simple electrical circuits</p> <p>b. Define capacitance as the ratio of the change in an electric charge in a system to the corresponding change in its electric potential and associate it to the ability of a system to store charge</p> <p>c. Use</p> <p><b>21.2 Parallel plate capacitor</b></p> <p>a. Derive, using Gauss law and for parallel plate capacitor</p> <p>b. Explain the effect on the capacitance of parallel plate capacitor of changing the surface area and separation of the plates</p> <p><b>21.3 Combination of capacitors</b></p> <p>a. Derive formula for combined capacitance for capacitors in parallel combinations</p>	<p><b>13. Alternating Currents:</b></p> <p>1.1 Understand peak and rms value of AC current and voltage</p> <p>1.2 Discuss AC through a resistor, a capacitor and an inductor</p> <p>1.3 Understand Phasor diagram in RC and RL circuits</p> <p>1.4 Describe series resonance condition and know its applications</p> <p>1.5 Understand the meaning of quality factor</p> <p>1.6 Discuss power in AC circuits and know the term power factor</p> <p>1.7 Solve the numerical problems.</p>
<p>b. Solve problems related to capacitors in parallel combinations</p>	

**22. DC Circuits****22.1 Electric Currents; Drift velocity and its relation with current**

- a. Understand the concept that potential difference between two points in a conductor makes the charge carriers drift
- b. Define electric current as the rate of flow of positive charge,  $Q = It$
- c. Derive, using  $Q=It$  and the definition of average drift velocity, the expression  $I=nAVd$  where  $n$  is the number density of free charge carriers

**22.2 Ohm's law Ohm's law; Electrical Resistance: resistivity and conductivity**

- a. Define and apply electric resistance as the ratio of potential difference to current
- b. Define *ohm*, *resistivity* and *conductivity*
- c. Use  $R = \rho l / A$  for a conductor
- d. Explain, using  $R = \rho l / A$ , how changes in dimensions of a conducting wire works as a variable resistor

**22.3 Current-voltage relations: ohmic and non-ohmic**

- a. Sketch and discuss the I–V characteristics of a metallic

conductor at constant temperature, a semiconductor diode and a filament lamp d) state Ohm's law

- b. State Ohm's law and identify ohmic and non-ohmic resistors

#### **22.4 Resistances in series and parallel**

- a. Derive, using laws of conservation of charge and conservation of energy, a formula for the combined resistance of two or more resistors in parallel
- b. Solve problems using the formula for the combined resistance of two or more resistors in series

#### **22.5 Potential divider**

- a. Understand the principle of a potential divider circuit as a source of variable p.d. and use it in simple circuits
- b. Explain the use of sensors (thermistors, light-dependent resistors and strain gauges) in potential divider circuit as a source of potential difference that is dependent on temperature, illumination and strain respectively

#### **22.6 Electromotive force of a source, internal resistance**

- a. Define electromotive force (e.m.f.) in terms of the energy transferred by a source in driving unit charge round a complete circuit
- b. Distinguish between e.m.f. and potential difference (p.d.) in terms of energy considerations

c. Understand the effects of the internal resistance of a source of e.m.f. on the terminal potential difference	
---	--

**Content Area: Modern Physics**

<b>23. Nuclear physics</b>	<b>14. Electrons</b>
23.1 Explain how nucleus was discovered	14.1 Describe Millikan's oil drop experiment and explain how it suggests quantization of charge
23.2 Convey the meaning of mass number, atomic number	14.2 Describe the motion of electrons in electric and magnetic fields and derive appropriate mathematical expressions
23.3 Calculate the expression of nuclear density	14.3 Describe J.J Thomson's experiment with suitable diagrams to explain the discovery of electron and its characters
23.4 Explain the existence of different isotopes of the same element	14.4 Solve numerical problems related to above topics
23.5 Describe main theme of Einstein's mass energy relation and state the relation	
23.6 Explain the meaning of mass defect and cause of it	
23.7 Describe the terms creation and annihilation	
23.8 Derive the relation of binding energy and binding energy per unit nucleon of different nuclei	
23.9 Plot a graph between BE per nucleon and mass number of different nuclei	
23.10 Define nuclear fusion and fission and explain the mechanism of energy release	
23.11 Solve numerical problems related to nuclear physics	

	<p><b>15. Photons</b></p> <p>15.1 Describe quantum nature of radiation</p> <p>15.2 Describe work function and photoelectric effect</p> <p>15.3 Derive Einstein’s photoelectric equation</p> <p>15.4 Describe Millikan’s experiment for the verification of Einstein’s photoelectric equation and calculate Planck’s constant</p> <p>15.5 Solve some related problems</p>
	<p><b>16. Semiconductor devices</b></p> <p>16.1 Describe the formation of PN junction and semiconductor diode</p> <p>16.2 Plot forward and reverse characteristics of semiconductor diode including the concept of Zener diode</p> <p>16.3 Define rectifier</p> <p>16.4 Describe full wave rectification using semiconductor diodes</p> <p>16.5 Define logic gates and explain operation of different logic gates OR, AND, NOT, NAND and NOR gates with their symbol , Boolean algebra and truth table</p>

-

**17. Quantization of energy**

17.1 Differentiate excitation and ionization potentials

17.2 Explain emission and absorption spectra

17.3 Define x-rays

17.4 Describe modern Coolidge tube method for the production of x-rays with quality and quantity

17.5 Illustrate different properties of x-rays along with their applications

17.6 Solve numerical problems related to quantization of energy

#### 4. Scope and Sequence of Contents

Grade 11		Grade 12	
Contents	TH	Contents	TH
<b>Content Area: Mechanics</b>			
<b>1. Physical Quantities</b> 1.1. Precision and significant figures. Dimensions and uses of dimensional analysis.	3	<b>1. Rotational dynamics</b> 1.1 Equation of angular motion, Relation between linear and angular kinematics 1.2 Kinetic energy of rotation of rigid body 1.3 Moment of inertia; Radius of gyration 1.4 Moment of inertia of a uniform rod 1.5 Torque and angular acceleration for a rigid body 1.6 Work and power in rotational motion 1.7 Angular momentum, conservation of angular momentum.	7
<b>2. Vectors</b> 2.1. Triangle, parallelogram and polygon laws of vectors 2.2. Resolution of vectors; Unit vectors 2.3. Scalar and vector products.	4	<b>2. Periodic motion</b> 2.1 Equation of simple harmonic motion (SHM) 2.2 Energy in SHM 2.3 Application of SHM: vertical oscillation of mass suspended from coiled spring, simple pendulum 2.4 Oscillatory motion: Damped oscillation, Forced oscillation and resonance.	6

<b>3. Kinematics</b> 3.1 Instantaneous velocity and acceleration 3.2 Relative velocity 3.3 Equation of motion (graphical treatment) 3.4 Motion of a freely falling body 3.5 Projectile motion and its applications.	4	<b>3. Fluid statics</b> 3.1 Fluid statics: Pressure in a fluid; Buoyancy 3.2 Surface tension: Theory of surface tension; Surface energy 3.3 Angle of contact, capillarity and its applications 3.4 Stokes law and its applications	5
<b>4. Dynamics</b> 4.1 Linear momentum, Impulse 4.2 Conservation of linear momentum 4.3 Application of Newton's laws 4.4 Moment, torque and equilibrium 4.5 Centre of mass and center of gravity	4	-	
<b>5. Work, energy and power</b> 5.1 Work done by a constant force and a variable force 5.2 power 5.3 Work-energy theorem; Kinetic and potential energy 5.4 Conservation of Energy 5.5 Conservative and non-conservative forces	2	-	
<b>6. Circular Motion</b> 6.1 Angular displacement, velocity and acceleration 6.2 Relation between angular and linear velocity and acceleration	3	-	

6.3 Centripetal acceleration 6.4 Centripetal force			
<b>7. Gravitation</b> 7.1 Newton's law of gravitation 7.2 Gravitational potential; Gravitational potential energy 7.3 Motion of a satellite: Orbital velocity and time period of the satellite 7.4 Escape velocity	<b>3</b>	-	
<b>8. Elasticity</b> 8.1 Hooke's law: Force constant 8.2 Stress; Strain; Elasticity and plasticity 8.3 Elastic modulus: Young modulus, bulk modulus, shear modulus 8.4 Poisson's ratio 8.5 Elastic potential energy.	<b>4</b>	-	

<b>Content Area: Heat and Thermodynamics</b>			
<b>9. Heat and Temperature</b> 9.1 Molecular concept of thermal energy, heat and temperature, and cause and direction of heat flow 9.2 Meaning of thermal equilibrium and Zeroth law of thermodynamics.	<b>2</b>	<b>4. First Law of Thermodynamics</b> 4.1 Thermodynamic systems 4.2 Internal energy and First law of thermodynamics 4.3 Heat capacities of an ideal gas at constant pressure and volume and relation between them	<b>2</b>

<p><b>10. Thermal Expansion</b></p> <p>10.1 Linear expansion, coefficient of linear expansion and its measurement</p> <p>10.2 Superficial expansion and coefficient of superficial expansion</p> <p>10.3 Cubical expansion and coefficient of cubical expansion</p> <p>10.4 Relation among coefficient of linear expansion, superficial expansion and cubical expansion</p>	3		
<p><b>11. Quantity of Heat</b></p> <p>11.1 Newton's law of cooling</p> <p>11.2 Measurement of specific heat capacity of solids and liquids</p> <p>11.3 Specific latent heat of fusion and vaporization</p> <p>11.4 Triple point</p>	3		
<p><b>12. Rate of heat flow</b></p> <p>12.1 Conduction: Thermal conductivity and measurement</p> <p>12.2 Convection</p> <p>12.3 Radiation: Black- body radiation</p> <p>12.4 Stefan – Boltzmann law.</p>	3	-	

<b>Content Area: Waves &amp; Optics</b>			
<b>13. Reflection at curved mirror</b> 13.1 Real and Virtual images. 13.2 Mirror formula	2	<b>5. Wave motion</b> 5.1 Progressive waves 5.2 Mathematical description of a wave 5.3 Stationary waves	2
<b>14. Refraction at plane surfaces</b> 14.1 Laws of refraction: Refractive index 14.2 Lateral shift	1	<b>6. Mechanical waves</b> 6.1 Speed of wave motion; Velocity of sound in solid and liquid 6.2 Velocity of sound in gas 6.3 Effect of temperature, pressure, humidity on velocity of sound.	3
<b>15. Refraction through prisms</b> 15.1 Minimum deviation condition 15.2 Relation between Angle of prism, minimum deviation and refractive index 15.3 Deviation in small angle prism.	3	<b>7. Wave in pipes and strings</b> 7.1 Stationary waves in closed and open pipes 7.2 Harmonics and overtones in closed and open organ pipes 7.3 Velocity of transverse waves along a stretched string	3
<b>16. Lenses</b> 16.1 Spherical lenses, angular magnification 16.2 Lens maker's formula 16.3 Power of a lens	3	<b>8. Acoustic phenomena</b> 8.1 Sound waves: Pressure amplitude 8.2 Characteristics of sound: Intensity; loudness, quality and pitch 8.3 Doppler's effect.	4

<p><b>17. Dispersion</b></p> <p>17.1 Pure spectrum and dispersive power</p> <p>17.2 Chromatic and spherical aberration</p> <p>17.3 Achromatism and its applications</p>	3	<p><b>9. Wave Nature of light</b></p> <p>9.1 Interference</p> <p>9.1.1 Phenomenon of Interferences: Coherent sources</p> <p>9.1.2 Young's double slit experiment.</p> <p>9.2 Diffraction</p> <p>9.2.1 Diffraction from a single slit</p> <p>9.2.2 Diffraction pattern of image; Diffraction grating</p> <p>9.2.3 Resolving power of optical instruments.</p> <p>9.3 Polarization</p> <p>9.3.1 Phenomenon of polarization</p> <p>9.3.2 Polaroid</p>	3
---	---	--	---

**Content Area: Electricity & Magnetism**

<p><b>18. Electric Charges</b></p> <p>18.1 Electric charges</p> <p>18.2 Charging by induction</p> <p>18.3 Coulomb's law- Force between two point charges</p> <p>18.4 Force between multiple electric charges.</p>	3	<p><b>10. Electrical circuits</b></p> <p>10.1 Kirchhoff's law</p> <p>10.2 Wheatstone bridge circuit; Meter bridge</p> <p>10.3 Potentiometer: Comparison of e.m.f., measurement of internal resistances of a cell</p> <p>10.4 Super conductors; Perfect conductors</p> <p>10.5 Conversion of galvanometer into voltmeter and ammeter; Ohmmeter</p> <p>10.6 Joule's law</p>	6
---	---	---	---

<p><b>19. Electric field</b></p> <p>19.1 Electric field due to point charges; Field lines</p> <p>19.2 Gauss Law: Electric Flux</p> <p>19.3 Application of Gauss law: Field of a charge sphere, line charge, charged plane conductor</p>	3	<p><b>11. Magnetic properties of materials:</b></p> <p>1.1 Magnetic field lines and magnetic flux</p> <p>1.2 Flux density in magnetic material; Relative permeability; Susceptibility</p> <p>1.3 Hysteresis</p> <p>1.4 Dia,-para- and ferro-magnetic materials.</p>	5
<p><b>20. Potential, potential difference and potential energy</b></p> <p>20.1 Potential due to a point charge, Potential difference, potential energy, electron volt</p> <p>20.2 Potential gradient</p>	2	<p><b>12. Magnetic field</b></p> <p>1.1 Force on moving charge; Force on a conductor</p> <p>1.2 Force and Torque on rectangular coil, Moving coil galvanometer</p> <p>1.3 Magnetic field of a moving charge</p> <p>1.4 Biot and Savart law and its application to (i) a circular coil (ii) a long straight conductor (iii) a long solenoid</p>	4
<p><b>21. Capacitor</b></p> <p>21.1 Capacitance and capacitor</p> <p>21.2 Combination of capacitors</p> <p>22.4 Energy of charged capacitor</p>	3	<p><b>13. Alternating Currents</b></p> <p>1.1 Peak and rms value of AC current and voltage</p> <p>1.2 AC through a resistor, a capacitor and an inductor</p> <p>1.3 Phasor diagram</p> <p>1.4 Series circuits containing combination of resistance, capacitance and inductance</p> <p>1.5 Power in AC circuits: power factor</p>	5

<b>22. DC Circuits</b> 22.1 Electric Currents; Drift velocity and its relation with current 22.2 Ohm's law; Electrical Resistance; Resistivity; Conductivity 22.3 Resistances in series and parallel, 22.4 Potential divider 22.5 Electromotive force of a source, internal resistance 22.6 Electrical power	7		
--	---	--	--

**Content Area : Modern Physics**

<b>23. Nuclear physics</b> 23.1 Atomic number, Nucleon number, Isotopes 22.4 Einstein's mass-energy relation 22.5 Mass Defect, BE per nucleon 22.6 Nuclear fission and fusion, energy released 23.4 Creation and annihilation	4	<b>14. Electrons</b> 14.1 Milikan's oil drop experiment, 14.2 Motion of electron beam in electric and magnetic fields 14.3 Thomson's experiment to determine specific charge of electrons	4
		<b>15. Photons</b> 15.1 Quantum nature of radiation 15.2 Einstein's photoelectric equation; Stopping potential 15.3 Measurement of Plank's constant	3

		<b>16. Semiconductor devices</b> 16.1 Semiconductor- intrinsic and extrinsic 16.2 P-N Junction 16.3 Semiconductor diode: Characteristics in forward and reverse bias 16.4 Full wave rectification 16.5 Logic gates; NOT, OR, AND, NAND and NOR.	6
-		<b>17. Quantization of energy</b> 17.1 Spectral series; Excitation and ionization potentials 17.2 Energy level; Emission and absorption spectra 17.3 De Broglie Theory; Duality 17.4 X-rays: Nature and uses	4
Total-	72		72

## 5. Practical Courses

[24 Hours]

The practical work that students do during their course is aimed at providing them learning opportunities to accomplish competency number 2 and 3 of the syllabus as well as reinforcing their learning of the theoretical subject content. This part of the syllabus focuses more on skill building than knowledge building. Students must be aware of the importance of precision, accuracy, significant figures, range and errors while collecting, processing, analyzing and communicating data. Likewise, graphical method of analysis and drawing conclusion should be encouraged wherever possible.

Students should

1. learn to use metre rule for measuring length, Vernier-calipers for measuring small thicknesses, internal and external diameters of cylindrical objects and depths of holes, spherometer for measuring radius of curvature of spherical surfaces and micrometer screw-gauge for measuring diameter of small spherical or cylindrical objects and very small thicknesses, traveling microscope with Vernier scale for measuring small distances, top-pan balance for measuring small masses, stop watch for measuring time interval, laboratory thermometer for measuring temperature, protractor for measuring angle), ammeter and milli-ammeter for measuring electric current and voltmeter for measuring electric potential difference.
2. learn to measure precisely up to the least count of the measuring instrument-  
metre rule – 0.001m or 1 mm  
Vernier calipers - 0.1 mm  
Spherometer - 0.01 mm  
micrometer screw gauge - 0.01 mm  
stop watch - 0.01s  
laboratory thermometer - 0.5°C  
protractor - 1°
3. learn to repeat readings and take the average value
4. learn to draw a standard table, with appropriate heading and unit for every column for storing data
5. learn to plot a graph using standard format, draw suitable trend lines, determine gradient, intercepts and area and use them to draw appropriate conclusion

6. learn to estimate and handle uncertainties.

In each academic year, students should perform 8 experiments, either listed below or designed by teacher, so that no more than three experiments come from the same unit of this syllabus.

**a) Practical Activities for Grade 11**

**I. Mechanics**

1. Verify the law of moments by graphically analyzing the relation between clockwise moment and anticlockwise moment on a half metre rule suspended at the centre by a string.
2. Determination of Young modulus of elasticity of the material of a given wire by graphically analyzing the variation of tensile force with respect to extension produced by it.

**II. Heat**

3. Use of Pullinger's apparatus for the Determination of the linear expansion of a rod.

**III. Geometrical Optics**

4. Use of Travelling Microscope for the determination of the refractive index of glass slab by graphically analyzing how apparent depth varies with the real depth for glass plates of different thicknesses.

**IV. Current electricity**

10. Verification of Ohm's law and determination of resistance of a thin-film resistor by graphical analysis of variation of electric current in the resistor with respect to potential difference across it.
11. Determination of resistivity of a metal wire by graphical analysis of variation of electric current through a metal wire against its length.

**a) Sample project works for grade 11**

1. Study the variation in the range of a jet of water with angle of projection
2. Explore the factors affecting the rate of loss of heat of a liquid
3. Study the nature and size of the image formed by a convex lens using a candle and a screen.
4. Comparative study of uses of alternative energy sources in Nepal

5. Study of application of laws and principle of physics in any indigenous technology.
6. Analyze the temperature dependence of refractive index of different liquids using a hollow prism and laser beam.
7. Analyze the frequency dependence of refractive index of glass using a glass prism and white light beam.

**b) Some examples of innovative works for grade 11**

1. Design and construct a system to demonstrate the phenomenon of total internal reflection (TIR) of a laser beam through a jet of water.
2. Construct a digital Newton meter using the concept of potential divider.

**c) Practical Activities for Grade 12**

**I. Mechanics**

1. Use of Simple pendulum for the determination of the value of 'g' in the laboratory by graphically analyzing the variation of period of oscillations with length of the pendulum.
2. Determination of the coefficient of viscosity of liquid by Stoke's method by graphically analyzing the variation of time taken for six metal balls of different diameters to travel the same distance in the given liquid with respect to their diameters.

**II. Wave and Optics**

4. Determination of the wavelength of He-Ne laser light by passing a plane diffraction grating.
5. Determination of the frequency of A.C. Mains using sonometer and graphically analyzing the variation of the ratio of resonating lengths with respect to the frequency of tuning fork using tuning forks of different frequencies.
6. Determination of velocity of sound in air at NTP using resonance tube.

**III. Electricity and magnetism**

7. Use of potentiometer for the
  - a) Comparison of emf's of two cells
  - b) Determination of the internal resistance of a cell
5. Use of deflection magnetometer to determination of the pole strength and

magnetic moment of a bar magnet

#### IV. Modern Physics

- a. 11. Study the I-V characteristics of a semiconductor diode.

#### d) Sample project works for grade 12

1. Design and construct a step-up transformer.
2. Construct a simple DC motor using a disk type magnet and a battery.
3. Construct a model of AC generator/dynamo.
4. Construction of a step down transformer attached with a full wave rectifier made from semiconductor diodes.

#### e) Some examples of innovative works for grade 12

1. Study of the status of hydroelectricity in Nepal.
2. Verify Joule' law.
3. History of space exploration

#### 6. Learning Facilitation Method and Process

Students should be facilitated to learn rather than just accumulation of information. Teacher plays vital role for delivering subject matters although others' role is also important. Student centered teaching-learning process is highly emphasized. Students are supposed to adopt multiple pathway of learning, such as online search, field visit, library work, laboratory work, individual and group work, research work etc. with the support of teacher. Self-study by students is highly encouraged and learning should not be confined to the scope of curriculum. Teacher should keep in mind intra and inter-disciplinary approach to teaching and learning, as opposed to compartmentalization of knowledge. Supportive role of parents/guardians in creating conducive environment for promoting the spirit of inquiry and creativity in students' learning is anticipated.

During the delivery process of science teaching in grade 11 and 12, basically following three approaches will be adopted;

Conceptual/Theoretical	Practical/Appication/ Experimental	Project works
Knowledge of content fact, terminology, definitions, learning procedures	Lab. based practical work science process and equipment handling skills building	Research work (survey and mini research) innovative work or experiential

Understanding of content (concept, ideas, theories, principles,		learning connection to theory and application
3.5 credit hrs spent for understanding of content	1 credit hr spent for experiment	0.5 credit hr spent in field work

**a) Conceptual/Theoretical Approach**

Possible theoretical methods of delivery may include the following;

- interaction
- question answer
- demonstrations
- ICT based instructions
- cooperative learning
- group discussions (satellite learning group, peer group, small and large group)
- debate
- seminar presentation
- Journal publishing
- daily assignment

**b) Practical/Application/Experimental approach**

Practical work is the integral part of the learning science. The process of lab based practical work comprises as;

- familiarity with objective of practical work
- familiarity with materials, chemicals, apparatus
- familiarity with lab process (safety, working modality etc.)
- conduction of practical work (systematically following the given instruction)
- analysis, interpretation and drawing conclusion

**c) Project work Approach**

Project work is an integral part of the science learning. Students should be involved in project work to foster self-learning of students in the both theoretical and practical contents. Students will complete project work to have practical idea through learning by doing approach and able to connect the theory into the real world context. It is regarded

as method/ process of learning rather than content itself. So use of project work method to facilitate any appropriate contents of this curriculum is highly encouraged.

In this approach student will conduct at least one **research work, or an innovative work** under the guidance of teacher, using the knowledge and skills learnt. It could include any of the followings;

- (a) Mini research
- (b) Survey
- (c) Model construction
- (d) Paper based work
- (e) study of ethno-science

General process of research work embraces the following steps;

- Understanding the objective of the research
- Planning and designing
- Collecting information
- analysis and interpretation
- Reporting /communicating (presentation, via visual aids, written report, graphical etc.)

General process of innovative work embraces the following steps;

- identification of innovative task (either assigned by teacher or proposed by student)
- planning
- performing the task
- presentation of the work
- Record keeping of the work

Students are free to choose any topic listed in this curriculum or a topic suggested by teacher provided that it is within the theoretical contents of the Curriculum. However, repetition of topic should be discouraged.

## Learning process matrix

Knowledge and understanding	Scientific skills and process	Values, attitudes and application to daily life
<ul style="list-style-type: none"> <li>• Scientific phenomenon, facts, definition, principles, theory, concepts and new discoveries</li> <li>• Scientific vocabulary, glossary and terminology</li> <li>• Scientific tools, devises, instruments apparatus</li> <li>• Techniques of uses of scientific instruments with safety</li> <li>• Scientific and technological applications</li> </ul>	<ul style="list-style-type: none"> <li>• Basic and integrated scientific process skills</li> </ul> <p><b>Process</b></p> <ul style="list-style-type: none"> <li>• Investigation</li> <li>• Creative thinking</li> <li>• problem solving</li> </ul>	<ul style="list-style-type: none"> <li>• Responsible</li> <li>• Spending time for investigation</li> </ul>

### Basic Science Process Skills includes,

1. Observing: using senses to gather information about an object or event. It is description of what was actually perceived.
2. Measuring: comparing unknown physical quantity with known quantity (standard unit) of same type.
3. Inferring: formulating assumptions or possible explanations based upon observations.
4. Classifying: grouping or ordering objects or events into categories based upon characteristics or defined criteria.
5. Predicting: guessing the most likely outcome of a future event based upon a pattern of evidence.
6. Communicating: using words, symbols, or graphics to describe an object, action or event.

### Integrated Science Process Skills includes,

1. Formulating hypotheses: determination of the proposed solutions or expected outcomes for experiments. These proposed solutions to a problem must be testable.
2. Identifying of variables: Identification of the changeable factors (independent and dependent variables) that can affect an experiment.

3. Defining variables operationally: explaining how to measure a variable in an experiment.
4. Describing relationships between variables: explaining relationships between variables in an experiment such as between the independent and dependent variables.
5. Designing investigations: designing an experiment by identifying materials and describing appropriate steps in a procedure to test a hypothesis.
6. Experimenting: carrying out an experiment by carefully following directions of the procedure so the results can be verified by repeating the procedure several times.
7. Acquiring data: collecting qualitative and quantitative data as observations and measurements.
8. Organizing data in tables and graphs: presenting collected data in tables and graphs.
9. Analyzing investigations and their data: interpreting data, identifying errors, evaluating the hypothesis, formulating conclusions, and recommending further testing where necessary.
10. Understanding cause and effect relationships: understanding what caused what to happen and why.
21. Formulating models: recognizing patterns in data and making comparisons to familiar objects or ideas.

## **7. Student Assessment**

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc. are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### **(a) Internal Evaluation**

Out of 100 full marks Internal evaluation covers 25 marks. Internal evaluation consists of Practical work (16 marks), (b) Marks from trimester examinations (6 marks), and (c) Classroom participation (3 marks)

- **Practical Activities**

Practical work and project work should be based on list of activities mentioned in this curriculum or designed by the teacher. Mark distribution for practical work and project work will be as follows:

S.N.	Criteria		Elaboration of criteria	Marks
1	Participation		Classroom participation includes attendance (1) and participation in learning (2)	3
2	Practical and Project work	Laboratory experiment	Correctness of apparatus setup/preparation	2
			Observation/Experimentation	2
			Tabulation	1
			Data processing and Analysis	1
			Conclusion (Value of constants or prediction with justification)	1
			Handling of errors/precaution	1
3.		Viva-voce	Understanding of objective of the experiment	1
			Skills of the handling of apparatus in use	1
			Overall impression	1
		Practical work records and attendance	Records (number and quality)	2
		Project work	Reports (background, objective, methodology, finding, conclusion)	2
			Presentation	1
		Total Practical and project work score		<b>19</b>
3	Trimester Exam		First and second trimester's score (3+3)	<b>6</b>
<b>Total</b>				<b>25</b>

**Note:**

- Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of laboratory experiment will focus both the product of work and skills competencies of student in using apparatus.

(ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

- **Marks from trimester examinations**

Total of 6 marks; 3 marks from each trimester.

- **Classroom participation (3 marks)**

Classroom participation includes attendance (1) and participation in learning (2).

**(b) External Evaluation**

Out of 100 marks theoretical evaluation covers 75 marks. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade : 11

Subject : Physics

Time: 3 hrs.

S.N.	Area	Working hour	Competency level				Area wise Score	
			Knowledge/ Remembering	Understanding	Applying	Higher Ability		
1	Mechanics	27	MCQ (2x1)	MCQ (5 x1)	MCQ (3x1)	MCQ (1x1)	28	
2	Heat and Thermodynamics	11	SQ (2x5)	SQ (1x5) LQ (1x8)	SQ (2x5) LQ (1x8)	SQ (3x5) LQ (1x8)	11	
3	Wave and Optics	12					13	
4	Electricity and Magnetism	18					19	
5	Modern Physics	4					4	
Total		72					12	18
Item format plan								
	Type of item	Score per item	Number of items				Total item	Total Score
1	Multiple Choice Questions	1	2	5	3	1	11	11
2	Short Question Answer	5	2	1	2	3	8	40
3	Long Question Answer	8	0	1	1	1	3	24
<b>Grand Total</b>			<b>4</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>22</b>	<b>75</b>

**Grade : 12**

S.N.	Area	Working hour	Competency level				Area wise Score
			Knowledge/ Remembering	Understanding	Applying	Higher Ability	
1	Mechanics	18	MCQ (2x1) SQ (2x5)	MCQ (5 x1) SQ (1x5) LQ (1x8)	MCQ (3x1) SQ (2x5) LQ (1x8)	MCQ (1x1) SQ (3x5) LQ (1x8)	19
2	Heat and Thermodynamics	2					2
3	Wave and Optics	15					16
4	Electricity and Magnetism	20					21
5	Modern Physics	17					17
<b>Total</b>		<b>72</b>	<b>12</b>	<b>18</b>	<b>21</b>	<b>24</b>	<b>75</b>

**Item format plan**

S.N.	Type of item	Score per item	Number of items				Total item	Total Score
1	Multiple Choice Questions	1	2	5	3	1	11	11
2	Short Question Answer	5	2	1	2	3	8	40
3	Long Question Answer	8	0	1	1	1	3	24
<b>Grand Total</b>			<b>4</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>22</b>	<b>75</b>

**Remarks:**

- Item format in composite should be met as per the specification grid.
- $\pm 1$  marks variation will be allowed within the area. But cannot be nil.
- In case of 5 or 8 marks items, these should ensure that 1 mark will be assigned per element expected as correct response. However, cognitive behavior intended might not be single behavior within the item. But in total cognitive distribution should met.  $\pm 2$  marks variation will be allowed within the cognitive levels.
- SQ and LQ can be structured (have two or more sub-items). SQ and LQ can be distributed to two or more cognitive behaviors. In such case these will be added to their respective cognitive behavior. In sum the distribution of cognitive behavior should be approximately to the required distribution.
- The distribution of questions based on cognitive domain will be nearby 15% knowledge/remembering, 25% understanding, 30% applying and 30% higher ability level.
- In case of short question there will be 2 "OR" questions and in case of long question there will be 1 "OR" question.

# Geo-Technical Engineering

**Grades: 11**

**Credit hrs:- 4**

**Annual Working hrs: 128**

## 1. Introduction

Geo- technical engineering course deals with geotechnical virtue of surrounding required for civil engineering construction. The geotechnical engineering deals with the physical properties of soil, permeability of soil and seepage analysis, shear strength of soil, bearing capacity of soil, compaction of soil and stabilization, site Investigation and sub soil exploration to information system, earth pressures and design of retaining walls, slope stabilization and bio-engineering techniques, River Training Works and hands on practice of its implementation.

This curriculum comprises of fundamental conceptual principles and practices, an overview geotechnical engineering, physical properties of soil, permeability of soil & seepage analysis, shear strength of soil, bearing capacity of soils, site investigation and sub soil exploration, design of retaining walls, survey information and design consideration for check dam, Gabion structures, bio engineering, foundations and geo synthetics. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Explain soil as three phase system and establish relationship between properties of Soil.
2. Compute properties of soil by following standard test., procedure and plot particle size distribution curve.
3. Determine permeability by constant head and falling head test using Darcy's Law
4. Calculate shearing strength of soil, using Coulomb's law

5. Determine structure/foundation/soil interactions
6. Explain variety of foundations and retaining walls
7. Apply Bio-engineering technique for slope stabilization.
8. Implement gabion works for river training works, revetments, retaining structures.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Overview Geotechnical Engineering	1.1 Define soil. 1.2 Describe importance of soil in Civil Engineering as construction material. 1.3 Describe importance of soil in Civil Engineering Structures as foundation bed for structures. 1.4 list out the field application of geotechnical engineering foundation design, pavement design, design of earth retaining structures, slope stability.
2	Physical Properties of Soil	2.1 Draw a three phase diagram. 2.2 Define water content & Determine of water content by oven drying method as per code. 2.3 Define Void ratio, porosity and degree of saturation, density index. 2.4 Define Unit weight of soil mass – bulk unit weight, dry unit weight, unit weight of solids, saturated unit weight, submerged unit weight. 2.5 Determine of bulk unit weight and dry unit weight by core cutter method and sand replacement method as per code. 2.6 Define Specific gravity & Determine of specific gravity by pycnometer. 2.7 Define Consistency of soil, stages of consistency, and Atterberg’s limits of consistency viz. Liquid limit, plastic limit and shrinkage limit, plasticity index. 2.8 Determine of liquid limit, plastic limit and shrinkage limit as per code.

		<p>2.9 Define Particle size distribution, mechanical sieve analysis as per code particle size distribution curve, effective diameter of soil, Uniformity coefficient and coefficient of curvature, well graded and uniformly graded soils.</p> <p>2.10 Define Particle size classification of soils &amp; classification of soil.</p>
3	Permeability of Soil & Seepage Analysis	<p>3.1 Define of permeability.</p> <p>3.2 Derive Darcy's law of permeability, determine coefficient of permeability &amp; identify typical values of coefficient of permeability for different soil.</p> <p>3.3 Describe factors affecting permeability.</p> <p>3.4 Determine of coefficient of permeability by constant head and falling head permeability tests &amp; practice simple problems to determine coefficient of permeability.</p> <p>3.5 Derive seepage through earthen structures, seepage velocity, seepage pressure, phreatic line, flow lines and equipotential lines.</p> <p>3.6 Draw flow net, list out characteristics of flow net &amp; application of flow net (no numerical problems).</p>
4	Shear Strength of Soil	<p>4.1 Define shear failure of soil, give example field situation of shear failure.</p> <p>4.2 Explain Concept of shear strength of soil.</p> <p>4.3 Derive Components of shearing resistance of soil – cohesion, internal friction.</p> <p>4.4 Derive Mohr-coulomb failure theory, Strength envelope, strength equation.</p> <p>4.5 Define Purely cohesive and cohesion-less soils.</p> <p>4.6 Apply laboratory determination of shear strength of soil – Direct shear test, Unconfined compression test &amp; vane shear test, plotting strength envelope, determine shear strength parameters of soil.</p>

5	Bearing Capacity of Soils	<p>5.1 Define concept of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure.</p> <p>5.2 Derive Terzaghi's analysis and assumptions made.</p> <p>5.3 Give example of effect of water table on bearing capacity.</p> <p>5.4 Apply field methods for determination of bearing capacity – Plate load test and standard penetration test. Test procedures as per code.</p> <p>5.5 Compare typical values of bearing capacity from building code.</p> <p>5.6 Define active earth pressure and passive earth pressure, (structures subjected to earth pressure in the field).</p>
6	Site Investigation And Sub Soil Exploration	<p>6.1 Describe necessity of site investigation &amp; sub-soil exploration.</p> <p>6.2 Classify types of exploration – general, detailed.</p> <p>6.3 Compare method of site exploration open excavation &amp; boring</p> <p>6.4 Describe criteria for deciding the location and number of test pits and bores.</p> <p>6.5 Compare disturbed &amp; undisturbed soil samples for lab testing.</p> <p>6.6 Apply field identification of soil – dry strength test, dilatancy test &amp; toughness test.</p>
7	Design of retaining walls	<p>7.1 List out functions of retaining wall.</p> <p>7.2 Identify sites where retaining walls are required.</p> <p>7.3 Define practical Features.</p> <p>7.4 List out special features of dry masonry retaining walls.</p> <p>7.5 List out special features of gabion construction.</p> <p>7.6 Compare front-battered or Back-battered.</p> <p>7.7 Identify common causes of Retaining wall Failure.</p>

		7.8 Discuss some construction techniques for increasing stability of Masonry Retaining Walls. 7.9 Express design of a retaining wall.
8	Survey information and design consideration for Check dam	8.1 Describe practical Features. 8.2 Compute design consideration of check dam. 8.2.1 Collect hydrological Aspects. 8.2.2 Design hydraulic Elements. 8.2.3 Design spillway Section. 8.2.4 Design scour Holes. 8.2.5 Design strain Cases for Check Dams. 8.3 Derive static and Soil Mechanical Calculation. 8.4 Identify stabilization of Gully head. 8.5 Explain scouring Problem. 8.6 Draw foundation. 8.7 Point out maintenance.
9	Gabion Structures	9.1 Describe advantages. 9.2 Outline construction. 9.3 Choose wire used in weaving gabion Baskets. 9.4 Classify of mesh and mesh opening. 9.5 List out design consideration. 9.6 Describe characteristics of fill material. 9.7 Compute design drawing and implementation of gabion spurs, revetments.
10	Bio Engineering	10.1 Define bio engineering. 10.2 Identify causes and Mechanism of Slope failures. 10.3 Compare functions of Bio-engineering system. 10.4 Design small Scale Civil Engineering System. 10.5 Define vegetative System. 10.6 Compare interaction between Civil and vegetative system.

		10.7 Select Species of bio engineering. 10.8 Describe propagation methods. 10.9 Select of Optimal technique.
11	Foundations	11.1 Discuss construction of spread footings. 11.2 Describe construction of mat foundations. 11.3 Describe construction of pile foundation. 11.4 Define pile load tests. 11.5 Define Damage, alignment and effect of pile driving. 11.6 Discuss Construction of Pier foundations. 11.7 Define Sinking of caissons. 11.8 Describe Ground Water in excavations and methods of its control.
12	Geosynthetics	12.1 Classify of Geosynthetics. 12.2 Compare application of Geosynthetics. 12.3 Describe Design Considerations. 12.4 list out construction Requirements.

#### 4. Scope and Sequence of Contents

UNIT	Chapter	Content	Hrs.
1	Overview Geotechnical Engineering	1.1 Engineering definition of soil 1.2 Importance of soil in Civil Engineering Structures as foundation bed for structures 1.3 Field application of geotechnical engineering foundation design, pavement design, design of earth retaining structures, slope stability	3
2	Physical Properties of Soil	2.1 Soil as three phase diagram 2.2 Water content & Determine of water content by oven drying method (as per code) 2.3 Define Void ratio, porosity and degree of saturation, density index 2.4 Define Unit weight of soil mass – bulk unit weight, dry unit weight, unit weight of solids, saturated unit weight, submerged unit weight	6

		<p>2.5 Determination of bulk unit weight and dry unit weight by core cutter method and sand replacement method (as per code)</p> <p>2.6 Define Specific gravity &amp; Determine of specific gravity by pycnometer.</p> <p>2.7 Define Consistency of soil, stages of consistency, Atterberg's limits of consistency viz. Liquid limit, plastic limit and shrinkage limit, plasticity index.</p> <p>2.8 Determination of liquid limit, plastic limit and shrinkage limit (as per code).</p> <p>2.9 Particle size distribution, mechanical sieve analysis (as per code) particle size distribution curve, effective diameter of soil, Uniformity coefficient and coefficient of curvature, well graded and uniformly graded soils.</p> <p>2.10 Different classification of soils.</p> <p>2.11 Numerical problems.</p>	
3	Permeability of Soil & Seepage Analysis	<p>3.1 Definition of permeability</p> <p>3.2 Derive Darcy's law of permeability, determine coefficient of permeability &amp; identify typical values of coefficient of permeability for different soil</p> <p>3.3 Describe factors affecting permeability</p> <p>3.4 Determination of coefficient of permeability by constant head and falling head permeability tests, practice simple problems to determine coefficient of permeability.</p> <p>3.5 Seepage through earthen structures, seepage velocity, seepage pressure, phreatic line, flow lines and equipotential lines.</p> <p>3.6 Draw flow net, list out characteristics of flow net &amp; application of flow net (no numerical problems)</p>	4

4	Shear Strength of Soil	<p>4.1 Shear failure of soil, field situation of shear failure</p> <p>4.2 Concept of shear strength of soil</p> <p>4.3 Components of shearing resistance of soil – cohesion, internal friction</p> <p>4.4 Mohr-coulomb failure theory, Strength envelope, strength equation</p> <p>4.5 Purely cohesive and cohesion-less soils</p> <p>4.6 Laboratory determination of shear strength of soil – Direct shear test, Unconfined compression test &amp; vane shear test, plotting strength envelope, determine shear strength parameters of soil.</p>	4
5	Bearing Capacity of Soils	<p>5.1 Concept of bearing capacity, ultimate bearing capacity, safe bearing capacity and allowable bearing pressure</p> <p>5.2 Terzaghi's analysis and assumptions made.</p> <p>5.3 Effect of water table on bearing capacity</p> <p>5.4 Field methods for determination of bearing capacity – Plate load test and standard penetration test. Test procedures as per code.</p> <p>5.5 Typical values of bearing capacity from building code</p> <p>5.6 Define active earth pressure and passive earth pressure, structures subjected to earth pressure in the field</p>	4
6	Site Investigation And Sub Soil Exploration	<p>6.1 Necessity of site investigation &amp; sub-soil exploration.</p> <p>6.2 Types of exploration – general, detailed.</p> <p>6.3 Method of site exploration open excavation &amp; boring</p> <p>6.4 Criteria for deciding the location and number of test pits and bores</p> <p>6.5 Disturbed &amp; undisturbed soil samples for lab testing.</p> <p>6.6 Field identification of soil – dry strength test, dilatancy test &amp; toughness test</p>	6

7	Design of retaining walls	<p>7.1 Functions of retaining wall</p> <p>7.2 Identify sites where retaining walls are required</p> <p>7.3 Practical Features</p> <p>7.4 Special features of dry masonry retaining walls</p> <p>7.5 Special features of gabion construction</p> <p>7.6 Front-battered or Back-battered</p> <p>7.7 Common causes of Retaining wall Failure</p> <p>7.8 Some construction techniques for increasing stability of Masonry Retaining Walls</p> <p>7.9 Design Consideration of a masonry retaining wall</p>	8
8	Survey information and design consideration for Check dam	<p>8.1 Practical Features.</p> <p>8.2 Design consideration of check dam.</p> <p>8.3 Hydrological Aspects.</p> <p>8.4 Hydraulic Elements.</p> <p>8.5 Spillway Section.</p> <p>8.6 Scour Holes.</p> <p>8.7 Strain Cases for Check Dams.</p> <p>8.8 Static and Soil Mechanical Calculation.</p> <p>8.9 Stabilization of Gully head.</p>	7
9	Gabion Structures	<p>9.1 Describe advantages.</p> <p>9.2 Wire used in weaving gabion Baskets.</p> <p>9.3 Classification of mesh and mesh opening.</p> <p>9.4 Design consideration.</p> <p>9.5 Characteristics of fill material.</p> <p>9.6 Design drawing and implementation of gabion spurs, revetments.</p>	5
10	Bio Engineering	<p>10.1 Define bio engineering.</p> <p>10.2 Causes and Mechanism of Slope failures.</p> <p>10.3 Functions of Bio-engineering system.</p> <p>10.4 Design small Scale Civil Engineering System.</p>	8

		10.5 Define vegetative System. 10.6 Compare interaction between Civil and vegetative system. 10.7 Select Species used in bio engineering. 10.8 Describe propagation methods. 10.9 Selection of Optimal technique.	
11	Foundations	11.1 Construction of spread footings. 11.2 Construction of mat foundations. 11.3 Construction of pile foundation. 11.4 Pile load tests. 11.5 Damage, alignment and effect of pile driving. 11.6 Construction of Pier foundations. 11.7 Sinking of caissons. 11.8 Ground Water in excavations and methods of its control.	5
12	Geosynthetics	12.1 Classification of Geosynthetics. 12.2 Compare application of Geosynthetics. 12.3 Design Considerations. 12.4 Construction Requirements.	4
		Total	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Practical Activities		Hrs.
1.	Determination of water content of given soil sample by oven drying method as per code.	2
2.	Determination of bulk unit weight dry unit weight of soil in field by core cutter method as per Code.	2

3.	Determination of coefficient of permeability by constant head test	2
4.	Determination of coefficient of permeability by falling head test	2
5.	Determination of shear strength of soil using direct shear test.	2
6.	Perform sieve analysis of Coarse and fine grained soil	4
7.	Determination of liquid limit and plastic limit.	2
8.	Perform compaction test: (Standard proctor test)	3
9.	California Bearing Ratio Test	2
10.	Determination of field density of layers by sand replacement method.	3
10.	Construction of Bio-engineering system (Grass planting, Brush layering, Bolsters and French Drains)	12
11.	Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the practical work.  The industrial visits may be arranged in the following areas  (i) Bridge foundation under construction (ii) Construction of basement/retaining wall (iii) Sub – Soil Exploration (iv) Bio-Engineering Site (v) Construction of River Training Works (Spurs, Embankment, Revetment)	14
12.	Survey, design and estimates of Gully protection works.	14
<b>Total</b>		<b>64</b>

## 6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Group Discussion
- Demonstration
- Case study

- Questionnaire
- Field Visit and report presentation
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving
- Assignments

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2

4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, and creating).

## Specification Grid

Grade: 11

Subject: Geo - Technical Engineering

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Overview Geotechnical Engineering	3	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	2
2	Physical Properties of Soil	6																	6
3	Permeability of Soil & Seepage Analysis	4																	5
4	Shear Strength of Soil	4																	2
5	Bearing Capacity of Soils	4																	2
6	Site Investigation And Sub Soil Exploration	6																	4
7	Design of retaining walls	8																	7
8	Survey information and design consideration for Check dam	7																	6
9	Gabion Structures	5																	2
10	Bio Engineering	8																	7
11	Foundations	5																	5
12	Geosynthetics	4																	2
	<b>Total</b>	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

# Estimating, Costing & Supervision

**Grades: 11**

**Credit hrs: 4**

**Annual Working hrs: 128**

## 1. Introduction

Estimating, costing and supervision course is deal with the estimate of the quantity and rate analysis. Its also supervise the project and develop the skill of project management. This subject also able to make the basic knowledge of valuation of building and other project.

This curriculum comprises of fundamental conceptual principles and practices, Introduction to road work estimate, earthwork in road construction, valuation, specifications, estimation of building, estimate of other structures. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Explain about terms used in earthwork in road construction.
2. Determines the quantity of earthwork in road construction in plain area and hill area.
3. Find out the detailed about valuation and prepare valuation report.
4. Write the detailed specification of the building and road works etc.
5. Describe methods of estimating of road and restoration works.
6. Prepare detailed estimate of different structures.

## 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1.	Introduction to road work estimate.	1.1 Define terms use in earthwork in road construction. 1.2 Explain method of estimating of road and restoration works.

2	Earthwork in road construction	<p>2.1 Explain various methods of earthwork calculation in road work.</p> <p>2.2 Calculate earthwork of road work in plain area.</p> <p>2.3 Calculate earthwork of road work having vertical drop.</p> <p>2.4 Calculate earthwork of road work in hilly area.</p>
3	Valuation	<p>3.1 Define valuation.</p> <p>3.2 Explain purpose of valuation.</p> <p>3.3 Explain Principle of valuation.</p> <p>3.4 Identify Factors affecting the value of property.</p> <p>3.5 Define of terms used in valuation.</p> <p>3.6 Explain methods of valuation.</p> <p>3.7 Explain methods of writing valuation report.</p>
4	Specifications	<p>4.1 Define specification.</p> <p>4.2 Describe Purpose of specification.</p> <p>4.3 List out specification.</p> <p>4.4 Collect necessity of specification.</p> <p>4.5 Describe technique of specification.</p> <p>4.6 Explain Paragraph of specification.</p> <p>4.7 Prepare detailed specification for:</p> <p><b>a) Building work :</b></p> <ul style="list-style-type: none"> <li>● earthwork in excavation</li> <li>● plain cement concrete work</li> <li>● steel reinforcement</li> <li>● form work</li> <li>● brick masonry work</li> <li>● stone masonry work</li> <li>● wood work for doors and windows frame and shutters</li> <li>● cement sand plaster work</li> <li>● CGI sheet roofing</li> </ul>

		<p>b) Road works:</p> <ul style="list-style-type: none"> <li>• embankment construction</li> <li>• sub-grade</li> <li>• base course</li> <li>• WBM road</li> <li>• surface dressing using hot bitumen</li> <li>• premix Capet</li> </ul> <p>4.8 Prepare detailed specifications for water supply, sanitary and irrigation works:</p> <ol style="list-style-type: none"> <li>a. WC commode cistern</li> <li>b. WC pan with cistern</li> <li>c. Wash basin</li> <li>d. Supply and laying G.I.pipes and fittings, PPR pipe</li> <li>e. Supply and fixing with cistern</li> <li>f. Supply and laying HDP pipe and fittings</li> <li>g. Supply and laying PVC pipe and fittings</li> <li>h. Canal lining</li> <li>i. Hume pipe</li> </ol>
5	Estimation of Building	<p>5.1 List out data required for preparation of detailed estimate.</p> <p>5.2 Define principle of units of measurement.</p> <p>5.3 Write units of measurement and payment for various items of work.</p> <p>5.4 Identify limits of measurement and degree of accuracy.</p> <p>5.5 Explain methods of taking out quantities of building work.</p> <p>5.6 Explain methods of measurement of building and other civil engineering works.</p> <p>5.7 Define various types of forms used in estimating.</p> <p>5.8 Prepare detailed estimate.</p>

6	Estimate of other structures	Prepare detailed estimate of: <ol style="list-style-type: none"> <li>a. Culvert</li> <li>b. Safety tank</li> <li>c. Man holes</li> <li>d. Soak pit</li> <li>e. prefabricated structures using different materials.</li> </ol>
---	------------------------------	---

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1.	Introduction to estimating of road work.	1.1 Terms use in earthwork in road construction 1.2 Method of estimating of road works	6
2	Earthwork in road construction	2.1 Various methods of earthwork calculation in road work 2.2 Earthwork calculation of road work in plain area 2.3 Earthwork calculation of road work having vertical drop 2.4 Earthwork calculation of road work in hilly area	10
3	Valuation	3.1 Definition 3.2 Purpose of valuation 3.3 Principle of valuation 3.4 Factors affecting the value of property 3.5 Definition of terms used in valuation 3.6 Methods of valuation 3.7 Methods of writing valuation report	10
4	Specifications	4.1 Definition 4.2 Purpose of specification 4.3 Types of specification 4.4 Necessity of specification 4.5 Technique of specification	16

		<p>4.6 Writing specification</p> <p>4.7 Detailed specification for:</p> <p>a) Building work : ( typical residential)</p> <ul style="list-style-type: none"> <li>• earthwork in excavation</li> <li>• plain cement concrete work</li> <li>• steel reinforcement</li> <li>• form work</li> <li>• brick masonry work</li> <li>• stone masonry work</li> <li>• wood work for doors and windows frame and shutters</li> <li>• cement sand plaster work</li> <li>• CGI sheet roofing</li> </ul> <p>b) Road works:</p> <ul style="list-style-type: none"> <li>• embankment construction</li> <li>• sub-grade</li> <li>• base course</li> <li>• WBM road</li> <li>• surface dressing using hot bitumen</li> <li>• premix carpet</li> </ul> <p>4.8. Detailed specifications for water supply, sanitary and irrigation works:</p> <ol style="list-style-type: none"> <li>a. WC commode cistern</li> <li>b. WC pan with cistern</li> <li>c. Wash basin</li> <li>d. Supply and laying G.I.pipes and fittings, PPR pipe</li> <li>e. Supply and fixing with cistern</li> <li>f. Supply and laying HDP pipe and fittings</li> <li>g. Supply and laying PVC pipe and fittings</li> </ol>	
--	--	--	--

		h. Canal lining i. Hume pipe	
5	Estimation of Building	5.1 Data required for preparation of detailed estimate 5.2 Principle of units of measurement 5.3 Units of measurement and payment for various items of work 5.4 Limits of measurement and degree of accuracy 5.5 Methods of taking out quantities of building work 5.6 Methods of measurement of building and other civil engineering works 5.7 Various types of forms used in estimating 5.8 Preparation of detailed estimate	14
6	Estimate of other structures	6.1 Detailed estimate of: a. Culvert b. Safety tank c. Man holes d. Soak pit a. prefabricated structures using different materials	8
<b>Total</b>			<b>64</b>

### 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 11		
	Scope	Practical Activities	Hrs.
1.	Introduction	1.1 Practice methods of estimating	5

2	Earthwork in road construction	2.1 Calculate earthwork in road construction by three methods 2.1 Calculate earthwork of road in plain area 2.2 Calculate earthwork of road having vertical drop 2.3 Calculate earthwork of road in highly area	15
3	Valuation	3.1 Practice valuations of different structures.	15
4	Specifications	4.1 Prepare specifications of different works	15
5	Estimation of Building	5.1 Estimate a wall 5.2 Estimate one room building with RCC flat roof 5.3 Estimate one room building (having verandah) with RCC flat roof 5.4 Estimate two roomed RCC framed structure building 5.5 Estimate steel reinforcement of footing, RCC beam, column and slab	9
6	Estimate of other structures	6.1 Prepare estimate of different structures	5
	<b>Total</b>		<b>64</b>

## 6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In particular, the teacher can make use of the following methods and strategies for the learning facilitation:

- Group Discussion
- Demonstration Field Visit and report presentation
- Case study Demonstration
- Case study
- Questionnaire
- Practical Works

- Audio/Visual Class
- Field Visit and report presentation
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 11

Subject: Estimating, Costing &amp; Supervision-II

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction to estimating of road work.	6	3	2	0	6	3	0		0	2	9	5	2	16	9	25	16	5
2	Earthwork in road construction	10																	8
3	Valuation	10																	7
4	Specifications	16																	12
5	Estimation of Building	14																	12
6	Estimate of other structures	8																	6
	<b>Total</b>	64	3	2	0	6	3	0		0	2	9	5	2	16	9	25	16	50

# Engineering Surveying

**Grades: 11**

**Credit hrs: 4**

**Annual Working hrs: 128**

## **Introduction**

This course is designed to provide knowledge and skills on surveying of land, open area and road, bridge site, construction area. It also deals with the elevation and leveling of the land. surveying course develop the knowledge of contour, horizontal and vertical curve. After the completion of this course, students will be able to develop plan and map, measure any area/land, use suitable methods of measurements and select the suitable method of surveying according to purpose of work.

This curriculum comprises of fundamental conceptual principles and practices, plane table surveying, theodolite survey, contouring, tacheometric surveying, trigonometric leveling, horizontal curves, vertical curves, transition and composite curves. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## **1. Competencies**

On completion of the course, the students will have the following competencies:

1. Prepare map using plane table surveying.
2. Familiar about theodolite survey.
3. Prepare contour map using different instruments and methods.
4. Conduct survey and prepare map by using tacheometric surveying.
5. Survey, study, design and construction of different curves.
6. Develop knowledge of horizontal & vertical curves.
7. Create idea about the transition & compound curve.

## 2. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Plane Table Surveying	<p>1.1 Define of Plane Table Surveying.</p> <p>1.2 Discuss accessories Required for Plane Table Surveying – Plane Table, Alidade, Spirit Level, Magnetic Compass, Plumbing Fork, and Drawing Paper.</p> <p>1.3 Describe Working Operations of Plane Table Surveying – Fixing the Table on the Tripod, Setting up the Plane Table (Leveling the Plane Table, Centering the Plane Table, Orienting the Plane Table), Sighting the Ground Stations.</p> <p>1.4 Compute Orientation – Orientation by Magnetic Compass, Orientation by Back sighting.</p> <p>1.5 Compare methods of Plane Table Surveying – Radiation Method, Intersection Method.</p> <p>1.6 Solve errors in Plane Tabling – Instrumental Error, Personal Error (Non-horizontality of table, Inaccurate Centering, Defective Orientation, Defective sighting), Plotting Error.</p> <p>1.7 Compare advantages and Disadvantages of Plane Tabling.</p> <p>1.8 Practice numerical.</p>
2	Theodolite survey	<p>2.1 Explain Geometry of the Theodolite.</p> <p>2.2 Write uses of Theodolite.</p> <p>2.3 Practice temporary Adjustment of Theodolite.</p> <p>2.4 Practice methods of Measuring Horizontal Angle – General Procedure of Measurement of Horizontal Angle, Measurement of Horizontal Angle by Repetition Method, Measurement of Horizontal Angle by Direction Method (or Reiteration Method).</p> <p>2.6 List out sources of Errors in Theodolite.</p> <p>2.7 Practice Numerical.</p>

3	Contouring	<p>3.1 Define of the terms – Contour Line, Horizontal Equivalent, Contour Interval, Index Contour.</p> <p>3.2 Compute proper of selection contour Interval.</p> <p>3.3 Explain characteristics of Contours.</p> <p>3.4 Write uses of Contour Map.</p> <p>3.5 Explain methods of Contouring – Direct Method, and Indirect Method (Square Method, Cross-Section Method, Tacheometric Method).</p> <p>3.6 Compute interpolation of Contours – Estimation Method, Arithmetical Calculation Method, Graphical Method.</p> <p>3.7 Practice Numerical.</p>
4	Tacheometric Surveying	<p>4.1 Explain Instrument used in Tacheometric Surveying</p> <p>4.2 Describe Methods of Tacheometric Measurements – Stadia Method (Fixed Hair Method, Movable Hair Method or Subtense Method), Tangential Method, and Self Reducing Method.</p> <p>4.3 Compute stadia Method - Principle of Stadia Method, Distance and Elevation Formula for Horizontal Sight with Staff Vertical, Distance and Elevation Formula for Inclined Sight with Staff Vertical, Method of Reading the Staff, Determination of Constants K and C, Anallatic Lens, Errors in Stadia Surveying.</p> <p>4.4 Describe Subtense Method - Subtense Bar, Principle of Subtense Method, Horizontal Base Subtense Measurement.</p> <p>4.5 Compute Tangential Method – Both Angles are Angle of Elevation, Both Angles are Angle of Depression, One Angle of Elevation and the other Angle of Depression.</p> <p>4.6 Practice self Reducing Method.</p> <p>4.7 Practice Numerical.</p>

5	Trigonometric Leveling	5.1 Explain different cases of trigonometric leveling. 5.2 Explain refraction and curvature correction by linear method. 5.3 Explain field procedures and problems.
6	Horizontal Curves	6.1 Define curves and explain purposes. 6.2 Classify horizontal curves. 6.3 Design curves. 6.4 Explain elements of simple circular curve. 6.5 Design and setting out of curves. 6.5.1 Practice linear method – by ordinates from long chord, offset from tangents. 6.5.2 Explain deflection angle method – by Rankine's method, two theodolite method.
7	Vertical Curves	7.1 Define vertical curves and explain purposes. 7.2 Explain types of vertical curves. 7.3 Compute vertical curves. 7.4 Compute and setting out of vertical curves by tangent correction and parabolic equation method.
8	Transition and Composite Curves	8.1 Introduce and explain purposes. 8.2 Classify transition curves. 8.3 Explain elements of transition curves.

#### 4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
1	Plane Table Surveying	1.1 Principle of Plane Table Surveying 1.2 Accessories Required for Plane Table Surveying – Plane Table, Alidade, Spirit Level, Magnetic Compass, Plumbing Fork, and Drawing Paper. 1.3 Working Operations of Plane Table Surveying – Fixing the Table on the Tripod, Setting up the Plane Table (Leveling the Plane Table, Centering the Plane Table, Orienting the Plane Table), Sighting the Ground Stations	8

		<p>1.4 Orientation – Orientation by Magnetic Compass, Orientation by Back sighting</p> <p>1.5 Methods of Plane Table Surveying – Radiation Method, Intersection Method (Resection only introduction)</p> <p>1.6 Errors in Plane Tabling – Instrumental Error, Personal Error (Non-horizontality of table, Inaccurate Centering, Defective Orientation, Defective sighting), Plotting Error</p> <p>1.7 Advantages and Disadvantages of Plane Tabling</p> <p>1.8 Numerical Practice</p>	
2	<b>Theodolite survey</b>	<p>2.1 Introduction</p> <p>2.2 Explain geometry of the Theodolite</p> <p>2.3 Uses of Theodolite</p> <p>2.4 Temporary Adjustment of Theodolite</p> <p>2.5 Methods of Measuring Horizontal Angle – General Procedure of Measurement of Horizontal Angle, Measurement of Horizontal Angle by Repetition Method, Measurement of Horizontal Angle by Direction Method (or Reiteration Method)</p> <p>2.6 Theodolite traverse ,classification of theodolite traverse</p> <p>2.7 Field work for traversing and booking of field notes</p> <p>2.8 Traverse adjustment and computation of total coordinates</p> <p>2.9 Plotting of traverse survey</p> <p>2.10 Omitted measurements in traversing</p> <p>2.11 Sources of Errors in Theodolite</p> <p>2.12 Total station – Introduction, Features of total station</p> <p>2.13 Numerical Practice</p>	14

3	Contouring	<p>3.1 Definitions of the terms – Contour Line, Horizontal Equivalent, Contour Interval, Index Contour</p> <p>3.2 Selection of Proper Contour Interval</p> <p>3.3 Characteristics of Contours</p> <p>3.4 Uses of Contour Map</p> <p>3.5 Methods of Contouring – Direct Method, and Indirect Method (Square Method, Cross-Section Method, Tacheometric Method)</p> <p>3.6 Interpolation of Contours – Estimation Method, Arithmetical Calculation Method, Graphical Method</p> <p>3.7 Numerical Practice</p>	9
4	Tacheometric Surveying	<p>4.1 Introduction</p> <p>4.2 Instrument used in Tacheometric Surveying</p> <p>4.3 Methods of Tacheometric Measurements – Stadia Method (Fixed Hair Method, Movable Hair Method or Sub tense Method), Tangential Method, and Self Reducing Method</p> <p>4.4 Stadia Method - Principle of Stadia Method, Distance and Elevation Formula for Horizontal Sight with Staff Vertical, Distance and Elevation Formula for Inclined Sight with Staff Vertical, Method of Reading the Staff, Determination of Constants K and C, Anallatic Lens, Errors in Stadia Surveying</p> <p>4.5 Subtense Method - Subtense Bar, Principle of Subtense Method, Horizontal Base Subtense Measurement</p> <p>4.6 Tangential Method – Both Angles are Angle of Elevation, Both Angles are Angle of Depression, One Angle of Elevation and the other Angle of Depression</p> <p>4.7 Self Reducing Method</p> <p>4.8 Numerical Practice</p>	9

5	Trigonometric Leveling	5.1 Different cases of trigonometric leveling. 5.2 Refraction and curvature correction by linear method. 5.3 Field procedures and problems.	4
6	Horizontal Curves	6.1 General definition and purposes 6.2 Classification of horizontal curves 6.3 Designation of curves 6.4 Elements of simple circular curve 6.5 Design and setting out of curves 6.5.1 Linear method – by ordinates from long chord, offset from tangents 6.5.2 Deflection angle method – by Rankine's method, two theodolite method	7
7	Vertical Curves	7.1 Definition and purposes 7.2 Types of vertical curves 7.3 Length of vertical curves 7.4 Computation and setting out of vertical curves by tangent correction and parabolic equation Method	7
8	Transition and Compound Curves	8.1 Introduction and purposes 8.2 Classification of transition curves 8.3 Elements of transition curves	6
<b>Total</b>			64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 11		
	Scope	Practical Activities	Hrs.
1	Plane Table Surveying	1.1 Perform Plane tabling and detailing	9

2	Theodolite survey	2.1 Carryout Theodolite handling practices 2.2 Perform traversing by theodolite, computation, grid sheet making and plotting of traverse	12
3	Contouring	3.1 Perform Contouring on a sloped ground by indirect method (Grid method)	9
4	Tacheometric Surveying	4.1 Perform tacheometric surveying by stadia method and tangential method for producing	10
5	Trigonometric Leveling	5.1 Perform trigonometric leveling for determining height of different targets ( accessible and Inaccessible cases)	8
6	Horizontal Curves	6.1 Set out simple circular curve, transition curve and composite curves by linear and angular method	5
7	Vertical Curves	7.1 Practice vertical curves in field	5
8	Transition and Composite Curves	8.1 Practice transition and composite curves.	6
		** Arrange Survey camp **	
	Total		64

## 6. Learning Facilitation Method and Process

Learning facilitation process is the crux of the teaching and learning activity. One topic can be facilitated through two or more than two methods or processes. The degree of usage will be based on the nature of the content to be facilitated. However, a teacher should focus on methods and techniques that are more students centered and appropriate to facilitate the content. The following facilitation methods, techniques and strategies will be applied while conducting the teaching learning process:

- Demonstration
- Group Discussion
- Practical Works
- Case study
- Questionnaire
- Report presentation
- Audio/Visual Class

- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
<b>Total</b>			<b>50</b>

#### Note:

- Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- Project work assessment is the internal assessment of reports and presentation of their

project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 11

Subject: Engineering Surveying-II

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Plane Table Surveying	8	5	3	0	4	2	1	0	0	1	9	5	2	16	9	25	16	6
2	Theodolite survey	18																15	
3	Contouring	9																7	
4	Tacheometric Surveying	9																7	
5	Horizontal Curves	7																5	
6	Vertical Curves	7																5	
7	Transition and Compound Curves	6																5	
	<b>Total</b>	<b>5</b>	<b>3</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>16</b>	<b>9</b>	<b>25</b>	<b>16</b>	<b>5</b>	<b>50</b>

# Applied Mechanics

**Grades: 11**

**Credit hrs: 4**

**Annual Working hrs: 128**

## 1. Introduction

Applied Mechanics course is design to provide basic knowledge of engineering mechanics to the student of all branches of engineering so that it would be helpful for them to understand structural engineering stress analysis principles in later course. It use basics of mechanics in their branch of engineering and deal with force, center of gravity, friction, truss and beam.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, forces acting on particle and rigid body, friction, centre of gravity and centroid, moment of inertia, structures, analysis of statically determinate beam and analysis of statically determinate plane truss. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Prepare free body diagram.
2. Familiar about different types of forces acting on partial and rigid body.
3. Familiar with the advantages and disadvantages of friction
4. Knowledge of center of gravity, centroid and moment of inertia
5. Concept of moment and moment of inertia.
6. Knowledge of axial force, share force and Bending moment and determine of structure.
7. Analysis of axial force, shear force and Bending moment and its diagram.

8. Analysis of beam and truss.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Introduction	<p>1.1 Define and scope of Applied Mechanics.</p> <p>1.2 Concept of Particle, Rigid Body, Deformable Body, Free</p> <p>1.3 Body Diagrams.</p> <p>1.4 Define equilibrium of particle and Rigid Body.</p> <p>1.5 Describe equations of Static Equilibrium: Two and Three Dimensional analysis of Particle.</p> <p>1.6 Define two Dimensional analysis of Rigid Body.</p>
2	Forces acting on Particle and Rigid Body	<p>2.1 Explain types of Forces: Internal, External, Translational, Rotational, Coplanar, Non-Coplanar, Concurrent, Non-Concurrent, Like Parallel and Unlike Parallel.</p> <p>2.2 Describe resolution and Composition of Forces.</p> <p>2.3 Explain principle of Transmissibility and Equivalent Forces.</p> <p>2.4 Define moments and Couples.</p> <p>2.5 Review varignon's Theorem.</p> <p>2.6 Describe resolution of a Force into a Force and a Couple.</p> <p>2.7 Derive Triangle Law of Forces, Parallelogram law of Derive Forces Polygon Law of Forces and Lami's Theorem.</p>
3	Friction	<p>3.1 Define, Causes, Advantages, Disadvantages and Types.</p> <p>3.2 Derive laws of Dry Friction.</p> <p>3.3 Define Static and Dynamic Friction and Their Coefficients.</p> <p>3.4 Define Angle of Friction.</p> <p>3.5 Describe different status (No Friction, Certain Friction, Impending Motion and Motion).</p>

		3.6 Describe sliding and Tipping Condition of the Body.
4	Centre of Gravity and Centroid	<p>4.1 Define center of Gravity, Centroid, Axis of Symmetry.</p> <p>4.2 Define Centroid of Composite lines (straight line, arc, semicircle and quarter circle).</p> <p>4.3 Define centroid of Composite Area (Rectangle, Triangle, Circle / Semi-circle /Quarter circle / Circular sector, Parabola / Semi-parabola and Ellipse).</p> <p>4.4 Describe centroid of Area under curve by the method of Integration.</p>
5	Moment of Inertia	<p>5.1 Define first Moment and Second Moment of Area.</p> <p>5.2 Define axial and Polar Moment of Inertia.</p> <p>5.3 Define moment of Inertia of Regular Areas (Rectangle, Triangle, Circle and Ellipse) about their Centroidal axes.</p> <p>5.4 Describe perpendicular and Parallel axis Theorem for Moment of Inertia.</p> <p>5.5 Define moment of Inertia of Composite Area.</p> <p>5.6 Define radius of Gyration.</p>
6	Structures	<p>6.1 Define structure and Mechanism.</p> <p>6.2 Define Plane and Space Structures.</p> <p>6.3 Describe different type of loads.</p> <p>6.4 Explain supports in the Structures and types.</p> <p>6.5 Compute determinacy and Stability (Statically and Geometrically) of the Structures.</p> <p>6.6 Describe external and Internal forces (Axial Force, Shear Force, and Bending Moment) in the Structural Members.</p>
7	Analysis of Statically Determinate Beam	<p>7.1 Define beam and Types of Beam.</p> <p>7.2 Calculate support Reactions and Internal Forces (i.e. Axial Force, Shear Force and Bending Moment) of the Beam</p> <p>7.3 Compute relationship between load, shear force and bending moment.</p>

		7.4 Determine axial force, shear force and bending moments.
		7.5 Draw Axial Force, Shear Force and Bending Moment Diagrams of the Beams.
8	Analysis of Statically Determinate Plane Truss	8.1 Define truss, uses and Types of Trusses. 8.2 Calculate member Force by the Method of Joints. 8.3 Calculate member Force by the Method of Sections.

#### 4. Scope and Sequence of Contents Theory: 50 Full Marks (64 Hrs.)

Unit	Content Area	Content	Hrs.
1	Introduction	1.1 Definition and scope of Applied Mechanics 1.2 Concept of Particle, Rigid Body, Deformable Body, Free Body Diagrams. 1.4 Equilibrium of particle and Rigid Body 1.5 Equations of Static Equilibrium: Two and Three Dimensional analysis of Particle 1.6 Two Dimensional analysis of Rigid Body	5
2	Forces acting on Particle and Rigid Body	2.1 Different types of Forces: Internal, External, Translational, Rotational, Coplanar, Non-Coplanar, Concurrent, Non-Concurrent, Like Parallel and Unlike Parallel 2.2 Resolution and Composition of Forces 2.3 Principle of Transmissibility and Equivalent Forces 2.4 Moments and Couples 2.5 Varignon's Theorem 2.6 Resolution of a Force into a Force and a Couple 2.7 State and Prove: Triangle Law of Forces, Parallelogram law of Forces Polygon Law of Forces and Lami's Theorem	10
3	Friction	3.1 Friction: Definition, Causes, Advantages, Disadvantages and Types	8

		<p>3.2 Laws of Dry Friction</p> <p>3.3 Static and Dynamic Friction and Their Coefficients</p> <p>3.4 Angle of Friction</p> <p>3.5 Different status (No Friction, Certain Friction, Impending Motion and Motion)</p> <p>3.6 Sliding and Tipping Condition of the Body</p>	
4	Centre of Gravity and Centroid	<p>4.1 Concept of Centre of Gravity, Centroid, Axis of Symmetry</p> <p>4.2 Centroid of regular and Composite lines (straight line, arc, semicircle and quarter circle)</p> <p>4.3 Centroid of Composite Area (Rectangle, Triangle, Circle / Semi-circle /Quarter circle / Circular sector, Parabola / Semi-parabola and Ellipse)</p> <p>4.4 Centroid of Area under curve by the method of Integration</p>	6
5	Moment of Inertia	<p>5.1 First Moment and Second Moment of Area</p> <p>5.2 Axial and Polar Moment of Inertia</p> <p>5.3 Moment of Inertia of Regular Areas (Rectangle, Triangle, Circle and Ellipse) about their Centroidal axes</p> <p>5.4 Perpendicular and Parallel axis Theorem for Moment of Inertia</p> <p>5.5 Moment of Inertia of Composite Area</p> <p>5.6 Radius of Gyration</p>	9
6	Structures	<p>6.1 Structure and Mechanism</p> <p>6.2 Plane and Space Structures</p> <p>6.3 Different type of loads</p> <p>6.4 Supports in the Structures and types.</p> <p>6.5 Determinacy and Stability (Statically and Geometrically) of the Structures.</p>	6

		6.6 External and Internal forces (Axial Force, Shear Force, and Bending Moment) in the Structural Members	
7	Analysis of Statically Determinate Beam	7.1 Definition and Types of Beam 7.2 Calculation of Support Reactions and Internal Forces (i.e. Axial Force, Shear Force and Bending Moment) of the Beam 7.3 Relationship between load, shear force and bending moment 7.4 Determination of axial force, shear force and bending moments 7.5 Draw Axial Force, Shear Force and Bending Moment Diagrams of the Beams	12
8	Analysis of Statically Determinate Plane Truss	8.1 Definition, uses and Types of Trusses 8.2 Calculation of Member Force by the Method of Joints 8.3 Calculation of Member Force by the Method of Sections. 8.4 Assumption of ideal truss.	8
<b>Total</b>			

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 11		
	Scope	Practical Activities	Hrs.
1	Introduction	1.1 Verify Triangle law of forces, Parallelogram law of forces and Lami's theorem	6
2	Forces acting on Particle and Rigid Body	2.1 Verify Principle of Moments	10
3	Friction	3.1 Determine the frictional force of the body.	8

4	Centre of Gravity and Centroid	4.1	Determine Centroid of Plane Figures (Rectangle, Triangles, Circle and Ellipse)	12
5	Moment of Inertia	5.1	Determine Moment of Inertia by Flywheel	8
6	Structures	6.1	Determine statically Determinant of structure	6
7	Analysis of Statically Determinate Beam	7.1	Determine Support Reactions of Simply Supported and Cantilever Beam with different types of Loading	7
8	Analysis of Statically Determinate Plane Truss	8.1	Determine Support Reactions and Member Force of Simply supported Truss	7
	<b>Total</b>			<b>64</b>

## 6. Learning Facilitation Process

Learning facilitation process is determined according to the content to be dealt in the subject. It's also an art of teacher. The teacher should utilize such teaching methods and techniques that are appropriate to the contents and needs of the students. In facilitating the course, various approaches, methods and techniques are used. To be particular, the following major methods and strategies are used in this subject:

- Group Discussion
- Demonstration
- Field Visit and report presentation
- Case study
- Questionnaire
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative

evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, class work, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

#### Note:

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

### (b) External Evaluation

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the

specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

**Grade: 11**

**Subject: Applied Mechanics**

**Time : 2 hrs.**

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	5	6	1	0	2	4	0	1	0	2	9	5	2	16	9	25	16	2
2	Forces acting on Particle and Rigid Body	10																	10
3	Friction	8																	6
4	Centre of Gravity and Centroid	6																	5
5	Moment of Inertia	9																	6
6	Structures	6																	5
7	Analysis of Statically Determinate Beam	12																	10
8	Analysis of Statically Determinate Plane Truss	8																	6
	<b>Total</b>	<b>64</b>	<b>6</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>9</b>	<b>5</b>	<b>2</b>	<b>16</b>	<b>9</b>	<b>25</b>	<b>16</b>	<b>50</b>

# Mechanics of Structure

**Grades: 12**

**Credit hrs: 4**

**Annual Working hrs: 128**

## 1. Introduction

Mechanics of structure course is deals with statics force, stress and strain, beam analysis and struss design. This curriculum comprises of fundamental conceptual principles and practices, an introduction, statics of structures – reactions, axial force, shear force and bending moment, centre of gravity and moment of inertia, plane trusses, stresses and strains, theory of flexure: bending, shear and deflection, torsion, column and struts.

The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Explain the physical nature of different types of load and support.
2. Determine determinacy and indeterminacy of different structural components.
3. Draw free body diagrams of different structures.
4. Calculate magnitude of horizontal and vertical reaction on a structural component.
5. Draw Axial force diagrams, shear force diagram and bending moment diagram of structural components
6. Explain center of gravity and moment of inertia of various structures.
7. Study about behavior of truss.
8. Explain theory of flexure Structure and its deflection.
9. Determine column buckling condition.

10. Study the behavior of structural elements like beam, frame and other structural components in bending, shear and torsion.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Introduction	1.1 Define Strength, Stiffness and stability and Basic Assumptions. 1.2 Explain Types of loads, supports. 1.3 Explain Types and number of reaction at the support. 1.4 Describe Boundary conditions and degrees of freedom. 1.5 Differentiate Statically determinate and indeterminate structures.
2	Statics of Structures – Reactions	2.1 Define Forces, resultants of planar force system, computation of a resultant, resultant of a distributed load, principle of transmissibility. 2.2 Explain Supports – hinged, roller and fixed supports and their characteristics. 2.3 Draw Free Body Diagrams. 2.4 Derive Equations of static equilibrium, Equations of conditions(Compatibility equations). 2.5 Explain Statically determinate and indeterminate structures, Influence of reactions on stability and determinacy of structures. 2.6 Describe Instability of structural systems, Comparison between determinate and indeterminate structures with examples.
3	Axial Force, Shear Force and Bending Moment	3.1 Define Physical Meaning and Sign Convention. 3.2 Determine internal forces in the members of beams and frames 3.3 Describe Degree of indeterminacy for beams and simple frames.

		<p>3.4 Writing expressions for shear and moment at a section of a beam in terms of applied loads.</p> <p>3.5 Construct of shear force and bending moment diagrams (curves) for statically determinate beams (simply supported, overhang and cantilever), sketching the deflected shapes of loaded beams (elastic curves).</p> <p>3.6 Derive Relationship between load, shear and moment; concept of shear center; principle of superposition.</p>
4	Centre of Gravity and Moment of Inertia	<p>4.1 Define Centre of gravity and centroid.</p> <p>4.2 Explain Centre of gravity of laminae of various shapes – rectangle, triangle, circle, semicircle, trapezium, built-up sections.</p> <p>4.3 Explain Moment of inertia of a lamina – definition, radius of gyration – Parallel axes theorem, Perpendicular axes theorem.</p> <p>4.4 Explain Moment of inertia of laminae of various shapes – moment of inertial of composite sections.</p>
5	Plane Trusses	<p>5.1 Introduce details of a truss, welded, riveted and bolted joints and their idealization as frictionless pins.</p> <p>5.2 Determinacy and stability of planar trusses.</p> <p>5.3 Determine Forces in the members of a truss.</p> <p>5.4 Explain simple, compound and complex trusses (sketch only).</p> <p>5.5 Analyze trusses.</p> <p>5.6 Explain Assumptions and joints Method and sections method.</p> <p>5.7 Describe Application of two methods for the determination member forces in the truss.</p> <p>5.8 Explain Identification of compression, tension and zero force members.</p>

6	Stresses and Strains	<p>6.1 Explain Linear stress and strain and their relation, Hooke's law and Young's modulus of elasticity.</p> <p>6.2 Calculate Deformation of uniform bar due to axial load.</p> <p>6.3 Draw Stress-strain curves for different materials.</p> <p>6.4 Determine Ultimate strength and working stress of materials and factor of safety.</p> <p>6.5 Explain Factors affecting factor of safety.</p> <p>6.6 Define Thermal stress.</p> <p>6.7 Describe Stress and strains in plain and composite bars.</p> <p>6.8 Define Poisson's ratio.</p> <p>6.9 Explain Shear stress shears strain and modulus of rigidity.</p> <p>6.10 Express volumetric strain and Bulk modulus.</p> <p>6.11 Derive Relation between Young's modulus, Bulk modulus and modulus of rigidity.</p> <p>6.12 Describe Problems in stresses and strains.</p>
7	Theory of Flexure: bending, shear	<p>7.1 Analyze symmetric cross-section beam.</p> <p>7.2 Explain Assumptions of simple bending.</p> <p>7.3 Define Radius of curvature, neutral layer and neutral axis.</p> <p>7.4 Explain Stress due to bending.</p> <p>7.5 Describe Moment of resistance.</p> <p>7.6 Derive flexural formula (Relation between bending stress ,radius of curvature and moment of resistance).</p> <p>7.7 Define Section modulus.</p> <p>7.8 Define Shearing stress in beams.</p> <p>7.9 Explain Distribution of shear stress in rectangular and circular cross sections of beam.</p>

8	Deflection of Beam	8.1 Define of elastic curve, slope and deflection in a beam. 8.2 Derive Differential equation of elastic curve. 8.3 Explain Deflection of simply supported and cantilever beams by double integration method.
9	Torsion	9.1 Introduce Torsion. 9.2 Explain Stress and deformation in a uniform shaft. 9.3 Define torque and angle of twist. 9.4 Explain Stress due to torsion. 9.5 Derive of torsional equation. 9.6 Explain Strength of solid and hollow circular shaft. 9.7 Describe Power transmitted by shaft.
10	Column and struts	10.1 Introduce column and struts. 10.2 Explain Buckling of column. 10.3 Derive Euler's column equation for different end conditions. 10.4 Define Slenderness ratio. 10.5 Introduce eccentrically loaded columns.

#### 4. Scope and Sequence of Contents

Unit	Scope	Contents	Hrs.
1	Introduction	1.1 Introduction, Brief History 1.2 Strength, Stiffness and stability 1.3 Basic Assumptions 1.4 Types of loads, supports 1.5 Types and number of reaction at the support. 1.6 Boundary conditions and degrees of freedom 1.7 Statically determine and indeterminate structures	4
2	Statics of Structures – Reactions	2.1 Supports – hinged, roller and fixed supports and their characteristics. 2.2 Idealization of structural systems: Free Body Diagrams–definition and examples	2

		<p>2.3 Equations of static equilibrium, Equations of conditions(Compatibility condition)</p> <p>2.4 Classification of structural systems – Statically determinate and indeterminate structures, Influence of reactions on stability and determinacy of structures.</p> <p>2.5 Instability of structural systems, Comparison between determinate and indeterminate structures with examples.</p>	
3	Axial Force, Shear Force and Bending Moment	<p>3.1 Definition, Physical Meaning, and Sign Convention</p> <p>3.2 Beams and Frames – Definitions and Common types of beams and frames, internal forces in the members of beams and frames</p> <p>3.3 Degree of indeterminacy for beams and simple frames.</p> <p>3.4 Writing expressions for shear and moment at a section of a beam in terms of applied loads</p> <p>3.5 Construction of shear force and bending moment diagrams (curves) for statically determinate beams (simply supported, overhang and cantilever, External hinged), Point of contra flexuresketching the deflected shapes of loaded beams (elastic curves)</p> <p>3.6 Relationship between load, shear and moment; concept of shear center; principle of superposition</p>	9
4	Centre of Gravity and Moment of Inertia	<p>4.1 Centre of gravity – Introduction and definitions. Centre of gravity and centroid.</p> <p>4.2 Lamina – Centre of gravity of laminae of various shapes – rectangle, triangle, circle, semicircle, trapezium, built-up sections, I-section, C-section, H- Section.</p>	10

		<p>4.3 Moment of inertia of a lamina – definition, radius of gyration – Parallel axes theorem, Perpendicular axes theorem.</p> <p>4.4 Moment of inertia of laminae of various shapes – moment of inertial of composite sections</p> <p>4.5 Problems for exercise.</p>	
5	Plane Trusses	<p>5.1 Introduction – details of a truss, welded, riveted and bolted joints and their idealization as frictionless pins.</p> <p>5.2 Describe riveted and bolted joints and their Failure.</p> <p>5.3 Explain Rivets value and efficiency of joints.</p> <p>5.4 Define Welded joints.</p> <p>5.5 Design of riveted bolted joints under axial force</p> <p>5.6 Details of riveted and bolted joints under axial forces</p> <p>5.7 Design of welded joints under axial forces</p> <p>5.8 Determinacy and stability of planar trusses.</p> <p>5.9 Forces in the members of a truss, types of trusses – simple, compound and complex trusses (sketch only)</p> <p>5.10 Analysis of trusses: Assumptions, Method of joints, Method of sections</p> <p>5.11 Application of two methods for the determination member forces in the truss.</p> <p>5.12 Identification of compression, tension and zero force members.</p>	8
6	Stresses and Strains	<p>6.1 Linear stress and strain and their relation, Hooke's law and Young's modulus of elasticity.</p> <p>6.2 Deformation of uniform bar due to axial force.</p> <p>6.3 Stress-strain curves for different materials.</p>	8

		<p>6.4 Ultimate strength and working stress of materials and factor of safety.</p> <p>6.5 Factors affecting factor of safety.</p> <p>6.6 Thermal stress.</p> <p>6.7 Stress and strains in plain and composite bars.</p> <p>6.8 Poisson's ratio.</p> <p>6.9 Shear stress shears strain and modulus of rigidity</p> <p>6.10 Volumetric strain and Bulk modulus.</p> <p>6.11 Relation between Young's modulus, Bulk modulus and modulus of rigidity.</p> <p>6.12 Problems in stresses and strains</p>	
7	Theory of Flexure: bending, shear	<p>7.1 Introduction</p> <p>7.2 Analysis of beam of symmetric cross-section</p> <p>7.3 Assumptions in theory of simple bending.</p> <p>7.4 Radius of curvature, neutral layer and neutral axis.</p> <p>7.5 Stress due to bending.</p> <p>7.6 Moment of resistance</p> <p>7.7 Derivation of flexural formula (Relation between bending stress ,radius of curvature and moment of resistance)</p> <p>7.8 Section modulus.</p> <p>7.9 Shearing stress in beams.</p> <p>7.10 Distribution of shear stress in rectangular and circular cross sections of beam.</p>	8
8	Deflection of Beam	<p>8.1 Definition of elastic curve, slope and deflection in a beam.</p> <p>8.2 Differential equation of elastic curve.</p> <p>8.3 Deflection of simply supported and cantilever beams by double integration method</p>	5

9	Torsion	9.1 Introduction. 9.2 Stress and deformation in a uniform shaft. 9.3 Definition of torque and angle of twist. 9.4 Stress due to torsion. 9.5 Derivation of torsional equation. 9.6 Strength of solid and hollow circular shaft. 9.7 Power transmitted by shaft.	4
10	Column and struts	10.1 Introduction. 10.2 Buckling of column. 10.3 Euler's column equation for different end conditions. 10.4 Slenderness ratio 10.5 Introduction of eccentrically loaded columns.	6
		<b>Total</b>	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 12		
	Scope	Practical Activities	Hrs.
1	Introduction		
2	Statics of Structures – Reactions	2.1 Determine Support reaction of the beam.	8
3	Axial Force, Shear Force and Bending Moment	3.1 Determine the Axial, shear force, and Bending Moment.	8
4	Centre of Gravity and Moment of Inertia	4.1 Determine the center of Gravity and Moment of inertia of different object.	7
5	Plane Trusses	5.1 Determination of bar forces in the members of the truss.	8

6	Stresses and Strains	6.1 Determine young's modulus yield stress and ultimate strength of mild steel specimen. 6.2 Measure strain and determine of force in member of a model truss.	7
7	Theory of Flexure: bending, shear	7.1 Determine the deflection of Different beam (Beam definition Vs force relation	6
8	Deflection of beam	8.1 Measure deflection of simple beams.	5
9	Torsion	9.1 Torsion Test: Determination of shear stress, shear strain, and modulus of rigidity of metallic specimen using torsion test apparatus.	7
10	Column and struts	10.1 Determine stability/buckling columns. 10.2 Determination of critical load for the buckling of a column.	8
	Total		64

## 6. Learning Facilitation Process

This course intends to provide both theoretical as well as practical knowledge and skills on the subject, thereby, blends with both theoretical and practical facilitation strategies to ensure better learning. In fulfilling the learning outcomes stated in the curriculum, the teacher should use a variety of methods and techniques that fit to the contents. In particular, the following methods, techniques and strategies are used for learning facilitation:

- Demonstration
- Group Discussion
- Case study
- Questionnaire
- Questionnaire
- Practical Works
- Audio/Visual Class
- Web surfing
- Assignment

- Visit and report presentation
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

### Note:

- Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills

competencies of student in using apparatus.

- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 12

Subject: Mechanics of Structure

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	4	7	1	0	2	3	1	0	1	1	9	5	2	16	9	25	16	2
2	Statics of Structures – Reactions	2																	1
3	Axial Force, Shear Force and Bending Moment	9																	9
4	Centre of Gravity and Moment of Inertia	10																	10
5	Plane Trusses	8																	6
6	Stresses and Strains	8																	6
7	Theory of Flexure: bending, shear	8																	6
8	Deflection of Beam	5																	3
9	Torsion	4																	2
10	Column and struts	6																	5
	Total	64	7	1	0	2	3	1	0	1	1	9	5	2	16	9	25	16	50

# Fluid Mechanic

**Grades: 12**

**Credit hrs: 4**

**Annual Working hrs: 128**

## 1. Introduction

Fluid Mechanic course focuses on the fundamental concepts and principles of Hydraulics, measurement of flow, introduction to open channel flow and pipe flow. It deals with the fluid either in motion or a rest condition. It is a practical based subject where students get practical knowledge.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, Hydrostatics, Hydro kinematics, Hydrodynamics, Pipe Flow, Open Channel Flow and flow measurement. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise learning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Explain the physical nature of fluids and forces acting on it.
2. Determine different types of fluid and fluid flow.
3. Acquire knowledge on various laws and principles on fluid.
4. Study about open channel flow
5. Analyze about pipe flow.
6. Develop knowledge about fluid flow measuring process.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Introduction	<p>1.1 Introduce Fluid and Hydraulics.</p> <p>1.2 Introduction to Fluid Mechanics and Hydraulics.</p> <p>1.3 Define mass density, specific weight, specific volume, specific gravity, viscosity, Newton's law, Dynamic and kinematic viscosity, compressibility and Bulk Modulus.</p> <p>1.4 Difference between real and ideal fluid and Newtonian and Non-Newtonian fluid.</p>
2	Hydrostatics	<p>2.1 Introduce fluid pressure, Pascal's law.</p> <p>2.2 Derive pressure-depth relationship (Hydrostatic law).</p> <p>2.3 Define atmospheric pressure, gauge pressure and absolute pressure.</p> <p>2.4 Determine pressure by piezometer and U-tube manometer.</p> <p>2.5 Explain of total pressure and center of pressure.</p> <p>2.6 Derive total pressure and center of pressure on vertical and inclined plane.</p> <p>2.7 Derive total pressure and center of pressure on vertical and inclined plane submerged surface</p> <p>2.8 Describe Buoyancy and Archimedes' principle.</p> <p>2.9 Define Principle of floatation.</p>
3	Hydrokinematics	<p>3.1 Explain Steady and unsteady, uniform and non-uniform, laminar and turbulent, compressible and incompressible, rotational and irrotational, one-, two- and three- dimensional.</p> <p>3.2 Define Reynold's number:</p> <p>3.3 Derive equation and criteria for laminar and turbulent flow.</p> <p>3.4 Define Streamline and Explain equation, characteristics.</p> <p>3.5 Explain principles and continuity equation for one dimensional incompressible flow.</p>

4	Hydrodynamics	<p>4.1 Define Energy of flowing fluid: potential or datum energy, kinetic energy, pressure energy.</p> <p>4.2 Describe Concept of energy head.</p> <p>4.3 Explain Bernoulli's theorem: Statements, assumptions, equation and applicability.</p> <p>4.4 Generate Concept of Hydraulic gradient line (HGL) and energy gradient line (EGL).</p>
5	Pipe Flow	<p>5.1 Introduce pipe flow.</p> <p>5.2 Explain Velocity profile for laminar and turbulent flow through pipes.</p> <p>5.3 Describe Loss of head in pipes and Introduce major and minor loss.</p> <p>5.4 Derive Darcy-Weisbach equation for loss of head due to friction.</p> <p>5.5 Derive equation for expansion and contraction loss.</p>
6	Open Channel Flow	<p>6.1 Compare between pipe flow and open channel flow.</p> <p>6.2 Explain Types of open channel flow: steady and unsteady, uniform and non-uniform, (gradually varied, rapidly varied and spatially varied flow), laminar and turbulent, subcritical, critical and supercritical flow.</p> <p>6.3 Describe Geometric elements of open channel (flow depth, flow area, top width, wetted perimeter, hydraulic radius, hydraulic depth, section factor).</p> <p>6.4 Explain Velocity distribution in open channel flow.</p> <p>6.5 Derive Chezy's equation and Manning's equation for the computation of velocity in uniform flow.</p> <p>6.6 Determine Energy equation and momentum equation in open channel flow.</p> <p>6.7 Explain Specific energy: Definition, equation and diagram.</p>

7	Flow Measurement	<p>7.1 Define Orifice and its types.</p> <p>7.2 Define vena-contracta.</p> <p>7.3 Derive equation for discharge through small orifice.</p> <p>7.4 Explain Hydraulic coefficients of orifice: coefficient of discharge, velocity and contraction (definition, formula and experimental method of determination).</p> <p>7.5 Generate Concept of venturimeter, and derive equation for discharge through venturimeter.</p> <p>7.6 Introduce weir or notch and their classifications.</p> <p>7.7 Derive equation for discharge through rectangular, triangular and trapezoidal weir or notch.</p> <p>7.8 Explain Area-velocity method for the discharge measurement in open channel (float and current meter): description of measurement technique, mid-section method for discharge computation.</p>
---	------------------	---

#### 4. Scope and Sequence of Contents

Unit	Scope	Contents	Hrs.
1	Introduction	<p>1.1 Introduction to Fluid</p> <p>1.2 Introduction to Fluid Mechanics and Hydraulics (such as pipe flow and open channel flow).</p> <p>1.3 Properties of fluid (Definition, formula, unit and dimension): mass density, specific weight, specific volume, specific gravity, viscosity (Newton's law, Dynamic and kinematic viscosity), compressibility and Bulk Modulus of elasticity &amp; surface tension.</p> <p>1.4 Difference between real and ideal fluid</p> <p>1.5 Difference between Newtonian and Non-Newtonian fluid</p>	6

2	Hydrostatics	<p>2.1 Introduction to fluid pressure</p> <p>2.2 Pascal's law</p> <p>2.3 Derivation for pressure-depth relationship (Hydrostatic law)</p> <p>2.4 Definition of atmospheric pressure, gauge pressure and absolute pressure</p> <p>2.5 Measurement of pressure by piezometer and U-tube manometer</p> <p>2.6 Definition of total pressure and center of pressure</p> <p>2.7 Derivation for total pressure and center of pressure on vertical and inclined plane</p> <p>2.8 Derivation for total pressure and center of pressure on vertical and inclined plane submerged surface</p> <p>2.9 Definition of Buoyancy, center of buoyancy and Archimedes' principle.</p> <p>2.10 Principle of floatation</p>	10
3	Hydrokinematics	<p>3.1 Types of flow: Steady and unsteady, uniform and non-uniform, laminar and turbulent, compressible and incompressible, rotational and irrotational, one-, two- and three- dimensional</p> <p>3.2 Reynold's number: Definition, equation and criteria for laminar and turbulent flow</p> <p>3.3 Streamline: Definition, equation, characteristics</p> <p>3.4 Conservation principles and continuity equation for one dimensional incompressible flow</p>	10
4	Hydrodynamics	<p>4.1 Energy of flowing fluid: potential or datum energy, kinetic energy, pressure energy</p> <p>4.2 Concept of energy head</p> <p>4.3 Bernoulli's theorem: Statements, assumptions, equation and applicability</p> <p>4.4 Concept of Hydraulic gradient line (HGL) and energy gradient line (EGL)</p>	10

5	Pipe Flow	<p>5.1 Introduction to pipe flow</p> <p>5.2 Velocity profile for laminar and turbulent flow through pipes</p> <p>5.3 Loss of head in pipes: introduction to major loss and minor loss</p> <p>5.4 Derivation of Darcy-Weisbach equation for loss of head due to friction</p> <p>5.5 Derivation of equation for expansion and contraction loss</p>	8
6	Open Channel Flow	<p>6.1 Difference between pipe flow and open channel flow</p> <p>6.2 Types of open channel flow: steady and unsteady, uniform and non-uniform(gradually varied, rapidly varied and spatially varied flow), laminar and turbulent,subcritical, critical and supercritical flow</p> <p>6.3 Geometric elements of open channel (flow depth, how depth section, flow area, top width, wettedperimeter, hydraulic radius, hydraulic depth, section factor, conveyance)</p> <p>6.4 Velocity distribution in open channel flow</p> <p>6.5 Chezy's equation and Manning's equation for the computation of velocity inuniform flow. Introduction to effective or economical hydraulic section.</p> <p>6.6 Energy equation and momentum equation in open channel flow</p> <p>6.7 Specific energy: Definition, equation and diagram</p>	10
7	Flow Measurement	<p>7.1. Orifice: Definition and types, definition of vena-contracta.</p> <p>7.2. Derivation of equation for discharge through small orifice.</p>	10

		7.3. Hydraulic coefficients of orifice: coefficient of discharge, velocity and contraction (definition, formula and experimental method of determination)	
		7.4. Concept of venturimeter, derivation of equation for discharge through venturimeter.	
		7.5. Introduction to weir or notch and their classifications.	
		7.6. Derivation of equation for discharge through rectangular, triangular and trapezoidal weir or notch.	
		7.7. Area-velocity method for the discharge measurement in open channel (float and current meter): description of measurement technique, mid-section method for discharge computation	
		Total	64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 12		
	Scope	Practical Activities	Hrs.
1	Hydrostatics	1.1 Measure pressure by piezometer and manometer	15
2	Hydrokinematics	2.1 Verify Bernoulli's theorem using venturimeter	15
3	Hydrodynamics	3.1 Practice different problem	7
4	Pipe Flow	4.1 Measure flow through orifice	10
5	Open Channel Flow	5.1 Practice different problem	7
6	Flow Measurement	6.1 Measure river discharge by float method.	10
	Total		64

## 6. Learning Facilitation Process

This course aims to blend both theoretical and practical aspects of knowledge and skills required in the subject. So, its facilitation process differs from the traditional method of delivery. The practical aspect is much more focused. So, methods and strategies that enable the practical skills in the students are much used in course of content facilitation. A facilitator encourages and assists students to learn for themselves engaging in different activities with practical tasks. To achieve the entire objectives from this syllabus, the teacher must use different techniques and process while teaching. In particular, the teacher can make use of the following methods and strategies for the learning facilitation:

- Group Discussion
- Demonstration
- Field Visit and report presentation
- Case study
- Questionnaire
- Practical Works
- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester

examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 12

Subject: Fluid Mechanics

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	6																	5
2	Hydrostatics	10																	8
3	Hydrokinematics	10																	8
4	Hydrodynamics	10																	8
5	Pipe Flow	8																	6
6	Open Channel Flow	10																	7
7	Flow Measurement	10																	8
	Total	64	6	2	0	3	2	1	0	1	1	9	5	2	16	9	25	16	50

# RCC Structure

**Grades: 12**

**Credit hrs: 4**

**Annual Working hrs: 128**

## 1. Introduction

This course focused on giving the general ideas and design of steel, timber and reinforced concrete structures. Its mainly deals with RCC structure of different structure. Its also explain the design of shape and size of beam, column and slabs and other concrete structure.

This curriculum comprises of fundamental conceptual principles and practices, Design concept of reinforced concrete, introduction of reinforced concrete structures, design of reinforced concrete structure, shear and bonds for R.C. sections, axial loaded R.C. columns, design of tension and compression members, design of roof trusses, timber structures, design of timber structure. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum has been offered as per the structure of National Curriculum Framework 2076. It provides a comprehensive outline of level-wise competencies, grade-wise leaning outcomes and scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematic.

## 2. Competencies

On completion of the course, the students will have the following competencies:

1. Understand the concept of reinforced structure
2. Familiar with different design philosophies, concept of singly and doubly reinforced sections and position of neutral axis.
3. Understand concept of design and codal provisions of reinforced structure
4. Design simple structural elements
5. Identify material and structural elements of steel, timber and RCC structures;
6. Create concept of design Tension and Compression Members ad Roof trusses.
7. Understand design concept and codal provisions of timber structure.

### 3. Grade wise learning Outcomes

UNIT	Chapter	Content
1	Design Concept of Reinforced Concrete	1.1 Describe Properties of concrete and steel reinforcement. 1.2 Explain Behavior of reinforced concrete in bending. 1.3 Design of a reinforced concrete section. 1.4 Define Modular ratio, permissible and ultimate stress. 1.5 Describe ultimate load and limit state method of design.
2	Introduction of reinforced concrete structures	2.1 Explain Different design philosophies. 2.2 Explain Working stress method of design – assumptions, permissible stresses and factor of safety. 2.3 Explain Limit state method of design – objectives and assumptions. 2.4 Describe concept of singly and doubly reinforced sections; behavior of a RC beam in bending. 2.5 Concept of partial factor for loads and materials. 2.6 Draw Stress–strain diagram. 2.7 Explain Position of neutral axis, Moment of resistance. 2.8 Compare Under reinforcement, over reinforcement, and balanced sections.
3	Design of reinforced concrete structure	3.1 Analyze singly and doubly reinforcement rectangular sections. 3.2 Analyze singly reinforced flanged sections. 3.3 Design of rectangular and flanged section. 3.4 Design of one way and two way slabs using NS Code. 3.5 Practice on the use of different Codes (NS codes) for the design of RCC structures.
4	Shear and Bonds for R.C. Sections	4.1 Explain Behavior of a R.C. section in shear. 4.2 Describe Shear resistance of reinforced section. 4.3 Explain Types of shear reinforcements. 4.4 Explain Strength of vertical links (stirrups). 4.5 Design of vertical stirrups.

		4.6 Explain Local and anchorage bond, Anchorage lengths, Bar curtailment.
		4.7 Practice Code for shear reinforcement and curtailment.
5	Axial Loaded R.C. Columns	5.1 Explain Types of compression members. 5.2 Design of a RCC short column. 5.3 Reinforcement and ductile detailing. 5.4 Practice Code requirements.
6	Introduction	6.1 Introduce to steel structures. 6.2 Explain Types & properties of steel. 6.3 Describe Allowable stresses in structural steel. 6.4 Explain Concept of limit state design in steel structure. 6.5 Use of steel as a structural member in construction. 6.5 Practice Codes of practice for design of steel structures. 6.6 Explain Advantage and disadvantage of steel structures.
7	Design of Tension and Compression Members	7.1 Describe Types of Tension Member. 7.2 Find Net Sectional Area. 7.3 Design of members subjected to axial load. 7.4 Define End condition & Effective lengths. 7.5 Write Radius of gyration and slenderness ratio. 7.6 Explain Strength of compression members. 7.7 Design of compressive members.
8	Design of Roof Trusses	8.1 Write different types of loads on roof truss 8.2 Introduce to the design of roof trusses 8.3 Define Tubular sections 8.4 Explain Connection used in steel roof truss.

9	Timber Structures	9.1 Introduce to timber. 9.2 Define Properties of timber. 9.3 Use of timber as a structural member. 9.4 Practice Code for design of timber structures. 9.5 Explain advantage & disadvantage of timber structures. 9.6 Explain Stresses in timber as per code.
10	Design of Timber Structure	10.1 Design of compression member. 10.2 Design of solid rectangular beam. 10.3 Practice Codal provision in deflections of Beam.

#### 4. Scope and Sequence of Contents

UNIT	Chapter	Content	Hrs.
1	Design Concept of Reinforced Concrete	1.1 Properties of concrete and steel reinforcement 1.2 Behavior of reinforced concrete in bending 1.3 Design of a reinforced concrete section 1.4 Modular ratio, permissible and ultimate stress 1.5 Describe ultimate load and limit state method of design	8
2	Introduction of reinforced concrete structures	2.1 Different design philosophies 2.2 Working stress method of design – assumptions, permissible stresses and factor of safety. 2.3 Limit state method of design – objectives and assumptions 2.4 Describe concept of singly and doubly reinforced sections; behavior of a RC beam in bending 2.5 Concept of partial factor for loads and materials 2.6 Stress–strain diagram 2.7 Explain Position of neutral axis, Moment of resistance	6

		2.8 Compare Under reinforcement, over reinforcement, and balanced sections..	
3	Design of reinforced concrete structure	3.1 Analyze singly and doubly reinforcement rectangular sections 3.2 Analyze singly reinforced flanged sections 3.3 Design of rectangular and flanged section 3.4 Design of one way and two way slabs using NS Code 3.5 Practice on the use of different Codes (NS codes) for the design of RCC structures.	9
4	Shear and Bonds for R.C. Sections	4.1 Behavior of a R.C. section in shear 4.2 Shear resistance of reinforced section 4.3 Types of shear reinforcements 4.4 Strength of vertical links (stirrups) 4.5 Design of vertical stirrups 4.6 Explain Local and anchorage bond, Anchorage lengths, Bar curtailment 4.7 Practice Code for shear reinforcement and curtailment	6
5	Axial Loaded R.C. Columns	5.1 Types of compression members 5.2 Design of a RCC short column 5.3 Reinforcement and ductile detailing 5.4 Practice Code requirements	6
6	Introduction	6.1 Introduction to steel structures 6.2 Types & properties of steel 6.3 Allowable stresses in structural steel 6.4 Concept of limit state design in steel structure. 6.5 Use of steel as a structural member in construction 6.5 Codes of practice for design of steel structures	3

		6.6 Advantage and disadvantage of steel structures	
7	Design of Tension and Compression Members	7.1 Types of Tension Member 7.2 Net Sectional Area 7.3 Design of members subjected to axial load 7.4 End condition & Effective lengths 7.5 Radius of gyration and slenderness ratio 7.6 Strength of compression members 7.7 Design of compressive members	10
8	Design of Roof Trusses	8.1 Different types of loads on roof truss 8.2 Introduction to the design of roof trusses 8.3 Tubular sections 8.4 Connection used in steel roof truss.	5
9	Timber Structures	9.1 Introduction to timber 9.2 Properties of timber 9.3 Use of timber as a structural member 9.4 Practice Code for design of timber structures 9.5 Advantage & disadvantage of timber structures 9.6 Stresses in timber as per code.	5
10	Design of Timber Structure	10.1 Design of compression member 10.2 Design of solid rectangular beam 10.3 Codal provision in deflections of Beam	6
	<b>Total</b>		64

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 12		
	Scope	Practical Activities	Hrs.
1	Design Concept of Reinforced Concrete	1.1 Singly reinforcement rectangular beams	6
2	Introduction of reinforced concrete structures	2.1 Doubly reinforcement rectangular beams	6
3	Design of reinforced concrete structure	3.1 Singly reinforcement T – beams	6
4	Shear and Bonds for R.C. Sections	4.1 One way slabs ( simply supported, cantilever and overhang)	7
5	Axial Loaded R.C. Columns	5.1 Two way slab	7
6	Introduction	6.1 Short and long columns (axially loaded )	7
7	Design of Tension and Compression Members	7.1 Simple pad footings for columns	5
8	Design of Roof Trusses	8.1 Preparation of bar bending schedule for all RC drawings	10
9	Timber Structures	9.1 Steel roof truss joint details	5
10	Design of Timber Structure	10.1 Timber beam and column	5
	<b>Total</b>		<b>64</b>

## 6. Learning Facilitation Method and Process

Learning facilitation process is the crux of the teaching and learning activity. One topic can be facilitated through two or more than two methods or processes. The degree of usage will be based on the nature of the content to be facilitated. However, a teacher should focus on methods and techniques that are more students centered and appropriate to facilitate the content. The following facilitation methods, techniques and strategies will be applied while conducting the teaching learning process:

- Group Discussion
- Creative thinking
- Demonstration
- Field Visit and report presentation
- Case study
- Questionnaire
- Practical Works

- Audio/Visual Class
- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

**Note:**

- (i) Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills competencies of student in using apparatus.
- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

## Specification Grid

Grade: 12

Subject: RCC Structure

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and									Total Question			Total Question	Marks Weight			Total Marks
			Understand			Application			Higher Ability			Number				MCQ	Short	Long	
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long					
1	Design Concept of Reinforced Concrete	8	6	2	0	3	3	1	0	0	1	9	5	2	16	9	25	16	8
2	Introduction of reinforced concrete structures	6																	5
3	Design of reinforced concrete structure	9																	7
4	Shear and Bonds for R.C. Sections	6																	5
5	Axial Loaded R.C. Columns	6																	5
6	Introduction	3																	1
7	Design of Tension and Compression Members	10																	10
8	Design of Roof Trusses	5																	2
9	Timber Structures	5																	2
10	Design of Timber Structure	6																	5
	<b>Total</b>	64	6	2	0	3	3	1	0	0	1	9	5	2	16	9	25	16	50

# Construction Management

**Grades: 12**

**Credit hrs: 4**

**Annual Working hrs: 128**

## **1. Introduction**

This course focuses on management of construction works. This course imparts knowledge on accounts, procurement of works, contract management, planning, scheduling, and managing construction works.

This curriculum comprises of fundamental conceptual principles and practices, an introduction, project planning and scheduling, CPM and PERT, contract administration and accounts, quality, monitoring, and control, construction equipment and safety. The course itself is of practical nature and the pedagogical approaches in delivering the course should consider the balance between theory and practice. It will be delivered using both the conceptual and theoretical inputs through presentation, discussion, reflective reading and group works as well as practical and real world experiences through different practical activities.

The curriculum is structured for two academic years in accordance with National Curriculum Framework, 2076. It focuses on both theoretical and practical aspects having equal teaching and practical. It incorporates the level-wise competencies, grade-wise leaning outcomes, scope and sequence of contents, suggested practical/project activities, learning facilitation process and assessment strategies so as to enhance the learning on the subject systematically.

## **2. Competencies**

On completion of the course, the students will have the following competencies:

1. Familiarize with project work and its management.
2. Acquire knowledge on Plan and schedule of construction project.
3. Get Knowledge about CPM and PERT.
4. Understand basic knowledge of procurement and contract management.
5. Well known about project monitoring, Quality control and cost control..
6. Familiarizes with construction equipment and safety management.

### 3. Grade wise learning Outcomes

UNIT	Content Area	Learning outcomes
1	Introduction	1.1 Define Project. 1.2 Characterize the Project. 1.3 Define Management. 1.4 List the need and function of Construction Management.
2	Project Planning and Scheduling	2.1 Define Planning. 2.2 Identify Planning step. 2.3 Illustrate Importance of Planning. 2.4 Decide Construction Site Planning. 2.5 Arrange Work Breakdown Structure. 2.6 Compare Bar Chart, Linked Bar, Milestone chart. 2.7 Describe Construction Schedule, Material schedule, labour and equipment schedule. 2.8 Operate Construction Schedule. 2.9 Calculate Financial Schedule.
3	CPM and PERT	3.1 Define CPM. 3.2 Describe Elements of Network and Network Rules. 3.3 Define Network Diagram, Activity, Event, Forward Pass, Backward. 3.4 Simple Numerical Practices on CPM and PERT.
4	Contract Administration and Accounts	4.1 Define Contract. 4.2 List Valid Contract element. 4.3 Classify Construction Contracts. 4.4 Describe Tender Notice, Tender document, bid bond, performance bond and contract document. 4.5 Define Conditions of Contract. 4.6 Express Duties and Responsibilities of a Site Supervisor. 4.7 Ethics of a site supervisor as a professional engineer. 4.8 Practice Site Order Book, Site Account, Muster Roll, Measurement Book.

		4.9 Prepare Running Bill, Final Bill and Completion Report. 4.10 Generate Relation between Owner, Consultant, and Contractor.
5	Quality	5.1 Define Quality. 5.2 Characterize Quality. 5.3 Explain Factors affecting Quality and Stages of Quality Control.
6	Monitoring, and Control	6.1 Define Monitoring and Control. 6.2 Describe Purpose of Monitoring. 6.3 Explain Quality, Cost, and Time. 6.4 Prepare Quality Control, Cost Control, Time/Schedule Control.
7	Construction Equipment	7.1 Describe Advantages of Construction Equipment. 7.2 Illustrate Equipment for Excavation, Concrete Mixing, Transportation and Compaction, Lifting of Materials and Parts.
8	Safety	8.1 Define Accidents in Construction Sites. 8.2 Discuss Causes of Accidents. 8.3 Summarize Importance of Safety and Safety Measures.

#### 4. Scope and Sequence of Contents

Unit	Scope	Contents	Hrs.
1	Introduction	1.1 Definition of Project 1.2 Characteristics of Project 1.3 Definition of Management 1.4 Need of Construction Management 1.5 Functions of Construction Management	4
2	Project Planning and Scheduling	2.1 Definition of Planning 2.2 Steps in Planning 2.3 Importance of Planning 2.4 Construction Site Planning	8

		<p>2.5 Work Breakdown Structure</p> <p>2.6 Bar Chart</p> <p>2.7 Linked Bar Chart and Milestone Chart</p> <p>2.8 Advantages of Construction Schedule</p> <p>2.9 Preparation of Construction Schedule</p> <p>2.10 Material Schedule</p> <p>2.11 Labor Schedule</p> <p>2.12 Equipment Schedule</p> <p>2.13 Financial Schedule</p>	
3	CPM and PERT	<p>3.1 Introduction to CPM</p> <p>3.2 Elements of Network</p> <p>3.3 Network Rules</p> <p>3.4 Definition of the Terms: Network Diagram, Activity, Event, Forward Pass, Backward Pass, Critical Path</p> <p>3.5 Determination of Critical Paths and Floats</p> <p>3.6 Introduction to PERT and terminologies used</p> <p>3.7 Numerical Practices on CPM and PERT.</p>	8
4	Contract Administration and Accounts	<p>4.1 Definition of Contract</p> <p>4.2 Essentials elements of a Valid Contract</p> <p>4.3 Types of Construction Contracts</p> <p>4.4 Information to be given in Tender Notice</p> <p>4.5 Tender Document</p> <p>4.6 Bid Bond and Performance Bond</p> <p>4.7 Contract Document</p> <p>4.8 Conditions of Contract</p> <p>4.9 Supervising Work of a Contractor</p> <p>4.10 Duties and Responsibilities of a Site Supervisor</p> <p>4.11 Ethics of a site supervisor as a professional Engineer.</p>	10

		4.12 Site Order Book 4.13 Materials at Site Account 4.14 Muster Roll 4.15 Measurement Book 4.16 Running Bill and Final Bill 4.17 Completion Report 4.18 Relation between Owner, Consultant, and Contractor	
5	Quality	5.1 Definition of Quality 5.2 Characteristics of Quality 5.3 Factors affecting Quality 5.4 Stages of Quality Control/ Assurance	8
6	Monitoring, and Control	6.1 Introduction to Monitoring 6.2 Purpose of Monitoring 6.3 Introduction to Control 6.4 Elements of Control: Quality, Cost, and Time 6.5 Quality Control 6.6 Cost Control 6.7 Time/Schedule Control	8
7	Construction Equipment	7.1 Advantages of using Construction Equipment 7.2 Equipment for Excavation 7.3 Equipment for Concrete Mixing 7.4 Equipment for Transportation and Compaction 7.5 Equipment for Lifting of Materials and Parts	10
8	Health and Safety	8.1 Introduction to Accidents in Construction Sites 8.2 Causes of Accidents 8.3 Importance of Safety 8.4 Safety Measures( Health and safety measure).	8
		<b>Total</b>	<b>64</b>

## 5. Suggested Practical and Project Works

Practical and project work is an integral part of technical and vocational subjects. They are carried out to consolidate the practical learning experiences. Some of the suggested practical and project work activities are mentioned below. As these are the basic and fundamental practical and project works, the teacher can adapt or introduce more relevant to their context and students' needs.

Unit	Grade 12		
	Scope	Practical Activities	Hrs.
1	Project Planning and Scheduling	1.1 Practice project planning and scheduling.	8
2	CPM and PERT	2.1 Practice CPM & PERT	9
3	Contract Administration and Accounts	3.1 Practice Site Order book , Muster Roll and Measurement Book.	8
4	Quality	4.1 Practice Quality Control and its stages.	8
5	Monitoring, and Control	5.1 Practice time and Schedule Control.	9
6	Construction Equipment	6.1 Filed visit for the Observation of Different equipment.	14
7	Safety	7.1 Measure safety method and its Important.	8
	<b>Total</b>		<b>64</b>

## 6. Learning Facilitation Process

Learning facilitation process is determined according to the content to be dealt in the subject. It's also an art of teacher. The teacher should utilize such teaching methods and techniques that are appropriate to the contents and needs of the students. In facilitating the course, various approaches, methods and techniques are used. To be particular, the following major methods and strategies are used in this subject:

- Group Discussion
- Field Visit and report presentation
- Supervision
- Case study
- Questionnaire
- Practical Works
- Audio/Visual Class

- Web surfing
- Project Works
- Problem Solving.

## 7. Student Evaluation

Evaluation is an integral part of learning process. Both formative and summative modes of evaluation are emphasized. Formative evaluation will be conducted so as to provide regular feedback for students, teachers and parents/guardians about how student learning is. Class tests, unit tests, oral question-answer, home assignment etc, are some ways of formative evaluation.

There will be separate evaluation of theoretical and practical learning. Summative evaluation embraces theoretical examination, practical examination and evaluation of research work or innovative work.

### (a) Internal Evaluation

Internal evaluation covers 50 Percent weightage. Internal evaluation consists of Practical Activities (Practical works and projects works) (35 Percent), (b) Marks from trimester examinations (10 Percent), and (c) Classroom participation (5 Percent). Practical work should be based on list of activities mentioned in this curriculum. Project works should be based on the mentioned lists or created by teachers. Mark distribution for internal evaluation (practical work and project work) will be as follows:

S.N.	Mani activities	Activities in detail	Percent
1	Participation	Participation in attendance, homework, classwork, project work, practical works etc.	5
2	Practical work	Conduction of practical work activities	15
		Record keeping of practical work activities	3
3	Project work	Conduction of project work activities	10
		Record keeping of project work activities	2
4	Viva	Viva of practical work and project work activities	5
5	Internal exam	First trimester 5 marks and Second trimester 5 marks	10
Total			50

### Note:

- Practical examination will be conducted in the presence of internal and external supervisors. Evaluation of experiment will focus both the product of work and skills

competencies of student in using apparatus.

- (ii) Project work assessment is the internal assessment of reports and presentation of their project works either individually or group basis. In case of group presentation, every member of the group should submit a short reflection on the presented report in their own language. Records of project works must be attested by external supervisor.

**(b) External Evaluation**

External evaluation of the students will be based on the written examination. It carries 50 percent of the total weightage. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre. Examination question paper will be developed using various levels of revised Bloom's taxonomy including remembering level, understanding level, application level and higher ability (analyzing, evaluating, creating).

### Specification Grid

Grade: 12

Subjects : Construction Management

Time : 2 hrs.

Unit	Content	Credit hrs.	Knowledge and Understand			Application			Higher Ability			Total Question Number			Total Question	Marks Weight			Total Marks
			MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long	MCQ	Short	Long		MCQ	Short	Long	
1	Introduction	4	7	3	0	2	2	1	0	0	1	9	5	2	16	9	25	16	2
2	Project Planning and Scheduling	8																	6
3	CPM and PERT	8																	6
4	Contract Administration and Accounts	10																	8
5	Quality	8																	6
6	Monitoring, and Control	8																	6
7	Construction Equipment	10																	8
8	Health and Safety	8																	8
	<b>Total</b>	64	7	3	0	2	2	1	0	0	1	9	5	2	16	9	25	16	50