

Secondary Level School Curriculum
(Technical and Vocational Stream)
(Grade 9-10)

Civil Engineering

2078



Government of Nepal
Ministry of Education
Curriculum Development Centre
Sanothimi, Bhaktapur

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

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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.

**Curriculum Development Centre
Sanothimi, Bhaktapur**

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Course Structure

Grade Nine

1. Computer and Drawing
2. Water Supply and Sanitary Engineering
3. Construction Technology and Workshop
4. Water Resource Engineering

Grade Ten

1. Building Construction and Drawing
2. Highway Engineering
3. Engineering Surveying- I
4. Estimating, Costing and Supervision – I

Curriculum Structure

Class 9-10

क्र.सं.	कक्षा ९			कक्षा १०		
	विषय	पाठ्यघण्टा Credit Hrs.	वर्षिक कार्यघण्टा	विषय	पाठ्यघण्टा Credit Hrs.	वर्षिक कार्यघण्टा
१	नेपाली	४	१२८	नेपाली	४	१२८
२	अङ्ग्रेजी	३	९६	अङ्ग्रेजी	३	९६
३	गणित	३	९६	गणित	३	९६
४	विज्ञान	३	९६	विज्ञान	३	९६
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	जम्मा	३२	१०२४		३२	१०२४

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

UNI T	Content Area	Learning outcomes
Computer		
1	Introduction to Computer	1.1. Describe concepts and history of computer. 1.2. Define computer system characteristics. 1.3. Define capabilities and limitation of computer. 1.4. Describe generation and types of computer. 1.5 Explain computer 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, Multi processing, 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	5.1 Introduce computer networks. 5.2 Describe type of network: LAN, MAN, WAN, and Internet. 5.3 Explain use of internet.
	Drawing	
6	Introduction of drawing	6.1 Compare types of drawing. 6.2 Evaluate engineering drawing as universal language of engineering technical persons. 6.3 Introduce drawing materials like drawing sheet, base paper, marking tape etc. 6.4 Introduce drawing tools like T-square, Set- square pencil, compass scale etc.
7	Introduction of line and geometrical shape	7.1 Define line and its type, line weight and their uses. 7.2 Introduce geometrical shape like rectangle, square triangle parallelogram, rhombus and polygon. 7.3 define circle and its parts name.
8	Scale	8.1 Define scale and its use. 8.2 Define full scale. 8.3 Define reduced scale. 8.4 Define enlarge scale. 8.5 Explain scale construction (Reducing and enlarging scale). 8.6 Practice the drawing of various length line using the scale.
9	Lettering	9.1 Introduce single and double stroke letter.

		<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>

		12.4 Define helices (cylindrical and conical helix).
13	Draw Parabola and Ellipse	13.1 Introduce cone and its terminology and various shapes, when it will be occurs. 13.2 Practice ellipse (concentric circle, oblong, and foci method). 13.3 Practice parabola (rectangle, tangent method).
14	Orthographic Projection	14.1 Define theory of projection. 14.2 Introduce principal plane. 14.3 Introduce first and third angle projection. 14.4 Compare difference between first and third angle projection. 14.5 Practice projection of point(s) and line(s) in first angle projection. 14.6 Practice projection of line: Parallel to HP, parallel to VP and perpendicular to HP and VP. Inclined to HP and VP. 14.7 Practice orthographic projection of prism, cylinder, pyramid and cone. 14.8 Practice orthographic projection of different models with flat, inclined and circular surface.
15	Draw isometric views	15.1 define isometric projection. 15.2 Describe isometric scale. 15.3 Practice process of preparation of isometric drawing. 15.4 Practice free hand sketch of isometric view.
16	Section	16.1 Explain need and importance of section. 16.2 Compare different type of sectional plane. 16.3 Practice types of section (Longitudinal and crossed section, as well as full and half section). 16.4 Practice sectional view of simple object.

17	Surface Development.	17.1 Introduce surface Development. 17.2 Practice method of surface development (parallel and radial line method).
18	Land measurement /Symbol	18.1 Practice land measurement by triangulation method. 18.2 Practice unit of length/Unit of land Roppani/Bigha/Hectare. 18.3 Practice general symbol of civil, domestic electrical (fixtures) works and plumbing works.

4. Scope and Sequence of Contents

Part: 1 Computer

Unit	Scope	Content	Hrs.
1.	Introduction to Computer	1.5. The concepts and history of computer 1.6. The computer system characteristics 1.7. The Capabilities and limitation of computer 1.8. Generation and types of computer 1.9. Computer works	3
2.	Computer components	2.1 Basic components of computer system 2.1.1 Input unit 2.1.2 Output unit 2.1.3 Memory units 2.1.4 Processing unit 2.2 Input device ; keyboard, mouse, joystick, OMR, OCR, BCR, MICR, Scanner, Touch screen, Touch pad, micro phone, digital camera 2.3 Output device; monitor, speaker, printer, projector, headphone 2.4 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"> • Text • Audio • Video • Animation 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"> • Email • Search engine • E-commerce • E- governance • E-banking 	6
		Sub-Total	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.	2

		7.3 Circle and its parts name.	
8	Scale	8.1 Knowledge of scale and its use 8.2 Full scale 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	1
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	6

		<p>Division</p> <p>11.5 Bisection and trisection of line and angle</p> <p>11.6 Line dividing in any number of equal parts</p> <p>11.7 Circle- dividing five, six,, seven and eight equal parts</p> <p>Tangent</p> <p>11.8 Line tangent to a circle from any point</p> <p>11.9 Uncrossed (open belt) and crossed (crossed belt) line tangent</p> <p>11.10 Arc tangent (Internal, external and combined)</p>	
12	Draw Curves	<p>12.1 Introduction of curve and its type</p> <p>12.2 Line and circular involutes</p> <p>12.3 Cycloid</p> <p>12.4 Helices (cylindrical and conical helix)</p>	3
13	Draw Parabola and Ellipse	<p>13.1 Introduction of cone and its terminology and various shapes, when it will be occurs</p> <p>13.2 Ellipse (concentric circle, oblong, and foci method)</p> <p>13.3 Parabola (rectangle, tangent method)</p>	4
14	Orthographic Projection	<p>14.1 Theory of projection</p> <p>14.2 Introduction principal plane</p> <p>14.3 Introduction of first and third angle projection</p> <p>14.4 Difference between first and third angle projection.</p> <p>14.5 Projection of point(s) and line(s) in first angle projection</p> <p>14.6 Projection of line: Parallel to HP, parallel to VP and perpendicular to HP and VP. Inclined to HP and VP</p>	6

		14.7 Orthographic projection of prism, cylinder, pyramid and cone 14.8 Orthographic projection of different models with flat, inclined and circular surface	
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
		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.
	Computer		
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	1.1 Draw Flow charts and introduce with Q basic 1.2 Work with Microsoft office package especially WORD, EXCEL and POWERPOINT. Familiarize students with different tools associated with each application. 1.3 Prepare Bio Data by using MS word 1.4 Make library management system using MS Excess 1.5 Prepare power point slides about their school 1.6 Prepare the Mark sheet in MS Excel 1.7 Make the graphical representation (graph, pie chart and so on) in MS EXCEL 1.8 Make tables and tabulate data in MS EXCEL	6
5	Networks and Internet	5.1 Practice on network system using LAN, MAN, WAN 5.2 Practice email, search engine	6
	Drawing		
6	Introduction of drawing	6.1 Introduction to tools, paper and drawing.	1
7	Introduction	7.2 Introduction to geometric shape: construction of	1

	of line and geometrical shape	polygonal shape, bisect and intersection, tangent, curve (cycloid, involute) and conic sections.	
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 dimensi-on	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, 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
6	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																	2
2	Computer System	7																	5
3	Operating System	6																	5
4	Multimedia	6																	5
5	Networks and Internet	6	6	1	0	2	2	1	1	2	1	9	5	2	16	9	25	16	5
6	Introduction of 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.

		<p>4.8. Identify transmission routes.</p> <p>4.9. Describe preventive measures.</p> <p>4.10. Drinking water quality standards (WHO, GoN).</p> <p>4.11. Water sampling and storing.</p> <p>4.12. Physical analysis (temperature, color, turbidity, taste and odour)</p> <p>4.13. Chemical analysis (total solids, pH, chlorine).</p>
5	Treatment of water	<p>5.1. Explain need of water treatment.</p> <p>5.2. Define screening.</p> <p>5.3. Explain Sedimentation.</p> <p>5.4. Define Filtration.</p> <p>5.5. Define aeration.</p> <p>5.6. Explain Disinfection.</p> <p>5.7. Define Water softening.</p>
6	Distribution of water	<p>6.1. Compare requirements of good distribution system.</p> <p>6.2. Explain methods of supply.</p> <p>6.3. Explain clear water reservoir.</p> <p>6.4. Define break pressure tank.</p> <p>6.5. Explain types of pipes.</p> <p>6.6. Explain laying of pipes.</p> <p>6.7. Compare types of joints.</p> <p>6.8. Define valves & fittings.</p> <p>6.9. Explain maintenance of pipes.</p>
7	Introduction of sanitation	<p>7.1. Define sanitation and role of sanitation in maintenance of health.</p> <p>7.2. Explain System of sanitation.</p> <p>7.3. Define valves and fittings.</p> <p>7.4. Describe System of sewerage.</p> <p>7.5. Explain Type of sewers.</p>

		7.6. Explain Laying of sewers.
8	Sewage Disposal	8.1. Describe importance of disposal of sewage. 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 2.1. Surface water(stream, river, lake) 2.2. Ground water (well, spring) 2.3. Source selection criteria 2.4. Discharge measurement (volumetric method) 2.5. Source protection plan 2.6. 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. 4.3.1 Water-borne diseases 4.3.2 Water based diseases 4.3.3 Water vector transmitted diseases 4.3.4 Water - washed 4.4. Transmission routes	8

		<p>4.5. Preventive measures</p> <p>4.6. Drinking water quality standards (WHO, GoN)</p> <p>4.7. Water sampling and storing</p> <p>4.8. Physical analysis (temperature, color, turbidity, taste and odour)</p> <p>4.9. Chemical analysis (total solids, pH, chlorine)</p>	
5	Treatment of water	<p>5.1. Need of water treatment</p> <p>5.2. Screening</p> <p>5.3. Sedimentation</p> <p>5.4. Filtration</p> <p>5.5. Aeration</p> <p>5.6. Disinfection</p> <p>5.7. Water softening</p>	7
6	Distribution & Plumbing system	<p>6.1. Requirements of good distribution system</p> <p>6.2. Methods of supply</p> <p>6.3. Clear water reservoir</p> <p>6.4. Break pressure tank</p> <p>6.5. Types of pipes</p> <p>6.6. Laying of pipes</p> <p>6.7. Pipe joints</p> <p>6.8. Valve & fittings</p> <p>6.9. Maintenance of pipes</p>	8
7	Introduction of sanitation	<p>7.1. Definition and role of sanitation in maintaining of health</p> <p>7.2. Systems of sanitation</p> <p>7.3. System of sewerage</p>	5

		7.4. Types of sewers 7.5. Laying of sewers	
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	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	Perform Measurement of the discharge at the source of water supply in your school or nearby source and calculate safe yield and design yield Prepare Source protection plan for a spring/ stream or well source.	8
3	Demand of water	Forecast the population for any ward of your village by arithmetic increase method Calculate the demand of water for above population	6
4	Quality of water	Survey the water related diseases in your community with their possible route of transmission and recommend prevention plan for them. Determine physical parameters (Color, Turbidity, Temperature) ³ Determine pH value	7
5	Treatment of water	Demonstrate Particle settling in quiescent sedimentation tank Demonstrate Water filtration in a sand filter developed in small scale	5
6	Distribution of Water & Plumbing	Design of water reservoir with inlet and outlet system Design a break pressure tank Identify different type of pipes and fittings Prepare different pipe joints Perform different pipe joining and fittings	9
7	Introduction of	Prepare sewer laying plan	5

	sanitation		
8	Sewage Disposal	Observe land treatment of sewage in artificially prepared bed	4
9	Disposal of excreta in un-sewered area	Design and draw free hand sketches of Pit privy, VIP latrine, Pour flush latrine	6
10	Solid Waste Management	Perform segregation of waste from school including canteen 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
6	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																	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	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	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
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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	<ol style="list-style-type: none"> 1. Define construction material. 2. Familiarize with different building materials and their uses. 3. Explain the types, properties and uses of mortars.
2.	Masonry Works	<ol style="list-style-type: none"> 4. Describe various types of masonry works and their uses. 5. Classify stone masonry works, Define Bond and Bond stone. Describe defects in stone and stone masonry. 6. 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. 7. Define Block work and enlist its uses.
3.	Concrete Works	<ol style="list-style-type: none"> 8. Define concrete works. 9. Enlist the materials used in concrete works, properties and uses. Describe preparation of concrete. 10. Discuss types of formworks. Types (Timber, Plywood and steel), List the importance and characteristics and requirements of good formwork. Rewrite stripping of formwork. 11. Define reinforcements. List its importance. Describe its placement and concreting. 12. Define Compaction and curing of concrete. 13. List factors affecting strength of concrete.

4.	Finishing Works	<p>14. Define Finishing works. Name the types of building finishes and enlist importance.</p> <p>15. Describe Various floor finishes.</p> <p>16. Explain Various wall finishes and their types.</p> <p>17. Describe Various ceiling finishes.</p> <p>18. Explain Various roof finishes.</p>
Workshop Technology		
5.	Carpentry	<p>11 Explain importance and scope of carpentry.</p> <p>12 Name different woodworking professions.</p> <p>13 Enlist various types of hand/power driven tools/equipment required to carpenter.</p> <p>14 Recall Care and maintenance of tools and equipment.</p> <p>15 Discuss safety and precautions in wood workshop.</p>
6.	Trees	<p>16 Define wood. Draw cross-section of tree with name of different parts.</p> <p>17 State characteristics of common Nepalese wood.</p> <p>18 Describe growth of tree.</p> <p>19 Explain Grain of wood section and strength of wood.</p> <p>20 Discuss methods and tools for felling trees.</p> <p>21 Name characteristics and example of hard wood and soft wood.</p>
7.	Timber	<p>22 Define timber.</p> <p>23 State application, advantage and disadvantage of timber.</p> <p>24 Explain purpose and methods of timber conversion.</p> <p>25 Define seasoning of timber and its objectives.</p> <p>26 Discuss various methods of seasoning .</p>
8.	Defects of Timber and methods of preservation	<p>27 Redefine defects of timber.</p> <p>28 Explain the types of timber defects.</p> <p>29 Identify shrinkage of wood.</p> <p>30 Define wood preservation and state its purpose.</p> <p>31 Describe oil soluble and water soluble preservatives.</p> <p>32 Describe hot and cold bath method.</p>

		33 Explain pressure method of preservation. 34 Explain preservative for termite protection. 35 Discuss different types of paints and their application.
9.	Construction joints (drawing to scale)	36 Define construction joints and recall its purpose. 37 Name types of joints and State their use: 38 Sketch Cross half lap joint. 39 Sketch Mortise and Tenon joint. 40 Draw Dovetail cross half lap joint. 41 Draw Dovetail bridle joint. 42 Sketch Dado joint. 43 Sketch Mitered joint. 44 Sketch Butt joint.
10.	Introduction to electricity and house wiring system	45 Define electricity and name sources of electricity. 46 Enlist different electric equipment. 47 Draw different electric symbols. 48 Explain house wiring process.

4. Scope and Sequence of Contents

Unit	Scope	Content	Hrs.
Construction Technology			
1.	Construction materials	1. Introduction to construction material 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 3. Mortars: Types, properties and uses	8

2.	Masonry Works	<ol style="list-style-type: none"> 4. Introduction to Masonry works of various types and their uses 5. Stone masonry: Bonds, Bond Stone, And Classification of stone masonry: Rubble masonry, Ashlar Masonry, Defects in stone and stone masonry. 6. Brick masonry: Types: Stretcher, Header, English, Flemish Bonds, terminologies, mortar used and construction techniques 7. Defects in Brick Masonry 8. Block work and its uses 	8
3.	Concrete Works	<ol style="list-style-type: none"> 9. Introduction to concrete works 10. Materials used in concrete works, preparation, properties and uses 11. Formworks: types (Steel, Timber and Plywood), importance, characteristics and requirements of Formwork 12. Reinforcements, importance, placement and concreting 13. Compaction and curing of concrete 14. Factor affecting strength of concrete 	10
4.	Finishing Works	<ol style="list-style-type: none"> 15. Definition, types of building finishes, importance 16. Various floor finishes 17. Various wall finishes and their types 18. Various ceiling finishes 19. Various roof finishes 	5
WorkshopTechnology			
5.	Carpentry	<ol style="list-style-type: none"> 1. Importance and Scope of carpenter 2. Different woodworking professions (Furniture maker/Wood carver/Construction carpenter) 3. Various types of hand/power driven tools/equipment required to carpenter 	4

		<p>4. Care and maintenance of tools and equipment.</p> <p>5. Safety and precautions in wood workshop</p>	
6.	Trees	<p>6. Wood, cross-section of tree with name of different parts</p> <p>7. Characteristics of common Nepalese wood</p> <p>8. Growth of tree</p> <p>9. Grain of wood section and strength of wood</p> <p>10. Methods and tools for felling trees</p> <p>11. Characteristics and example of hard wood and soft wood</p>	5
7.	Timber	<p>12. Definition of timber</p> <p>13. Application, Advantage and Disadvantage</p> <p>14. Timber conversion, purpose and Methods (Through and through sawn/Tangential sawn/Rift or quarter sawn)</p> <p>15. Seasoning of timber (Definition and objectives)</p> <p>16. Various methods of seasoning (Natural and Artificial Seasoning)</p> <p>17. Moisture content of timber and moisture meter</p>	6
8.	Defects of Timber and methods of preservation	<p>18. Definition</p> <p>19. Defects due to natural forces/fungi/insects/during seasoning and conversion)</p> <p>20. Shrinkage of wood</p> <p>21. Definition and Purpose of wood preservation</p> <p>22. Oil soluble and water soluble preservatives</p> <p>23. Hot and cold bath method</p> <p>24. Pressure method of preservation</p> <p>25. Preservation from termite in a building</p> <p>26. Different types of paints and their application</p>	10
9.	Construction joints (drawing	<p>27. Definition and purpose</p> <p>28. Types of joints and their use:</p> <p>29. Cross half lap joint</p>	4

	to scale)	30. Mortise and Tenon joint 31. Dovetail cross half lap joint 32. Dovetail bridle joint 33. Dado joint 34. Mitered joint 35. Butt joint	
10	Introduction to electricity and House wiring System	36. Electricity and sources of electricity 37. Different electric symbols 38. 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
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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 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
10	Introduction to electricity & house wiring system	1.1 Practice on domestic wiring system on plane board 1.2 Practice on connection of switch & bulbs, sockets	10
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, 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
6	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																	6	
2	Masonry Works	8																	6	
3	Concrete Works	10																	8	
4	Finishing Works	5																	4	
5	Carpenter	4																	3	
6	Trees	5	7	1	0	2	2	1	0	2	1	9	5	2	1	6	9	25	16	4
7	Timber	6																	5	
8	Defects of Timber	10																	8	

	and methods of preservation																		
9	Construction joints (drawing to scale)	4																	3
10	Introduction to electricity and House wiring System	4																	3
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

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 3.1.1. Uncontrolled flooding 3.1.2. Check flooding 3.1.3. Furrow irrigation 3.1.4. Zig zag method 3.1.5. Contour Farming 3.1.6. Basin Flooding 3.1.7. Contour laterals 3.2. Define Sub surface irrigation 3.2.1 Define Drip irrigation 3.2.2 Define Sprinkler irrigation

4	Various irrigation structures	<p>4.1. Explain Head works: Definition, and types</p> <p>4.1.1. Canal head regulator</p> <p>4.1.2. Cross Regulator</p> <p>4.1.3. Cannel fall</p> <p>4.1.4. weir and barrage</p> <p>4.1.5. Under sluice and silt excluder.</p> <p>4.2. Explain Cross-Drainage works</p> <p>4.2.1. Aqueducts</p> <p>4.2.2. Siphon aqueducts</p> <p>4.2.3. Super passage</p> <p>4.2.4. Siphon</p> <p>4.2.5. Level crossing</p> <p>4.2.6. Inlet and outlet</p> <p>*prepare for the field trip to observe the various irrigation structures*</p>
5	Canal	<p>5.1. Compare Classification of canal and their alignment</p> <p>5.2. Explain Canal losses, canal lining</p> <p>River training works-definition, Types, objectives</p>
6	Water logging and drainage	<p>6.1. Define water logging</p> <p>6.2. Explain Causes and effects of water logging</p> <p>6.3. Describe Remedial measures</p> <p>6.4. Explain Causes of canal damages, maintenance tasks</p> <p>Hill irrigation practice in Nepal</p>
7	Hydrology and flood estimation	<p>7.1. Define hydrology</p> <p>7.2. Explain hydrologic cycle</p> <p>7.3. Describe measurement of Rainfall by Rain Gauges</p> <p>7.4. Explain rainfall runoff process</p> <p>7.5. Define infiltration</p>

		<p>7.6. Define Evaporation and transpiration</p> <p>7.7. Describe Factors affecting runoff</p> <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	1.1 Definition of irrigation 1.2 Necessity of irrigation 1.3 Advantages and Disadvantages of irrigation 1.4 Sources of water for irrigation 1.5 Gross command area(GCA) 1.6 Cultivable command area(CCA) 1.7 Net command area(NCA)	5
2.	Water requirement	2.10. Crop season 2.11. Crop types 2.12. Base Hrs. 2.13. Kor Hrs. and Kor depth 2.14. Crop Hrs. 2.15. Delta and Duty 2.16. Duty delta relationship 2.17. Factors affecting duty 2.18. Water requirement of different crops	7
3	Method of irrigation	2 Surface irrigation 3.1.8. Uncontrolled flooding 3.1.9. Check flooding 3.1.10. Furrow irrigation 3.1.11. Zig zag method 3.1.12. Contour Farming 3.1.13. Basin Flooding 3.1.14. Contour laterals 3 Sub surface irrigation 4 Drip irrigation	8

		5 Sprinkler irrigation	
4	Various irrigation structures	<p>4.1. Head works: Definition, and types</p> <p>4.3.5 Canal head regulator.</p> <p>4.3.6 Cross Regulator.</p> <p>4.3.7 Cannel fall.</p> <p>4.3.8 weir and barrage, notch.</p> <p>4.3.9 Under sluice and silt excluder.</p> <p>4.2. Cross-Drainage works</p> <p>4.2.1. Aqueducts.</p> <p>4.2.2. Siphon aqueducts</p> <p>4.2.3. Super passage</p> <p>4.2.4. Siphon</p> <p>4.2.5. Level crossing</p> <p>4.2.6. Inlet and outlet</p> <p>*prepare for the field trip to observe the various irrigation structures*</p>	10
5	Canal	<p>5.1. Classification of canal and their alignment</p> <p>5.2. Canal losses, canal lining</p> <p>5.3. River training works.</p>	6
6	Water logging and drainage	<p>6.1. Definition of water logging</p> <p>6.2. Causes and effects of water logging</p> <p>6.3. Causes of canal damages, maintenance tasks.</p> <p>6.4. Remedial measures</p>	8

		6.5. Hill irrigation practice in Nepal	
7	Hydrology and flood estimation	<p>7.1. Definition of hydrology</p> <p>7.2. The hydrologic cycle</p> <p>7.3. Measurement of Rainfall by Rain Gauges</p> <p>7.4. Rainfall runoff process</p> <p>7.5. Infiltration</p> <p>7.6. Evaporation and transpiration</p> <p>7.7. Factors affecting runoff</p> <p>7.8. Estimation of flood by rational method</p> <p>7.9. Estimation of peak flood by Empirical methods</p> <p>7.10. Stream/River discharge determination (float method, velocity rod method, current meter, velocity area method)</p> <p>7.11. Ground water hydrology</p> <p>7.12. Aquifers and its types</p> <p>7.13. Ground water movement-Darcy's Law</p>	10
8	Waterpower engineering	<p>8.1.Introduction</p> <p>8.2.Hydropower development in Nepal</p> <p>8.3.Flow duration curve</p> <p>8.4.Firm (or primary) power and secondary (or Surplus) power& total power</p> <p>8.5.Power system and load</p> <p>8.6.Load factor, utilization factor and capacity factor</p> <p>8.7.General layout plan of hydropower project</p> <p>8.8.Run of River (ROR) and Picking type of</p>	10

		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 1.2. Identify Gross command area from a map(GCA) 1.3. Identify Cultivable command area from a map(CCA) Identify Net command area from a map(NCA)	11
2	water requirement	2.1. Perform field identification of Kor Hrs. and kor depth for different crops 2.2. Perform field identification of Delta and Duty for different types of crops	9
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	10

		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	
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.

(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
6	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																	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	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	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 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

2. Learning Outcomes

Unit	Content Area	Learning Outcomes
1.	Components of building	<p>1.1 Introduction to building</p> <p>1.1.1 Introduce building and Explain their types.</p> <p>1.1.2 Recall loads on building.</p> <p>1.1.3 State components of the building.</p> <p>1.1.4 Discuss considerations in building design.</p> <p>1.2 Foundation</p>

		<p>1.2.1 Define foundation.</p> <p>1.2.2 Enlist function of foundation.</p> <p>1.2.3 State requirements of good foundation.</p> <p>1.2.4 Illustrate types of foundations.</p> <p>1.3 Staircase</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>1.4 Doors/windows</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>1.5 Roof/roof covering works</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>1.6 Ceiling works</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>1.7 Flooring works</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 Superstructu	<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>

	re	<p>2.3. Interpret choosing wall thickness, height to length ratio.</p> <p>2.4. State causes, sources and impact of dampness.</p> <p>2.5. Discuss remedial measures to prevent dampness.</p> <p>2.6. Name materials used for damp proofing.</p>
3.	Temporary Constructions	<p>3.1. Define shoring and name its types.</p> <p>3.2. Define underpinning and explain its methods (Definition and methods).</p> <p>3.3. Define scaffolding, explain its types and state uses.</p> <p>3.4. Introduce formwork for slab/beam/column and rewrite the requirements of good formwork.</p> <p>3.5. Explain the types of walls and write their functions.</p>
4.	Cement and concrete construction	<p>4.1 Name the constituents, mix and state the uses of Lime concrete.</p> <p>4.2 Name the constituents, mix and state the uses of cement concrete.</p> <p>4.3 Recall grading of fine and course aggregate.</p> <p>4.4 Describe nominal mix and controlled mix or design mix.</p> <p>4.5 Explain workability of concrete and water cement ratio.</p> <p>4.6 Interpret methods of concrete mixing (hand mixing and machine mixing).</p> <p>4.7 Enlist factors affecting strength of concrete.</p> <p>4.8 Define bulking of sand.</p> <p>4.9 Explain batching of concrete.</p> <p>4.10 Describe storing of concrete materials.</p> <p>4.11 Perform slump tests, write its procedure and uses.</p> <p>4.12 Introduce RCC.</p> <ul style="list-style-type: none"> • Explain steel reinforcement. • List advantages of R.C.C. • Describe bar bending and placing schedule.

5.	Earthquake resistant Features	<p>5.1. Introduce Earthquake and rewrite its /Causes/Effects.</p> <p>5.2. Explain building forms for earthquake resistance.</p> <p>5.3. Describe importance of RCC bands in load bearing structure.</p> <p>5.4 Define plinth , Skill Stiches Lintel, roof and gable bands and innumerate their function, horizontal and vertical.</p> <p>5.5 Discuss the location, size, and length of opening in masonry building.</p>
6.	Introduction to engineering drawing/Basic Drafting Concept	<p>6.1. Explain types of drawings.</p> <p>6.2. Draw engineering symbols and conventional signs.</p> <p>6.3. Explain the use of By-laws and Building codes.</p> <p>6.4. Draft and prepare foundation plans.</p> <p>6.5. Differentiate Site plans and location plans.</p> <p>6.6. Draft floor plans, elevations and sections.</p>
7.	Introduction to AutoCAD course and hardware	<p>7.1. Illustrate history of AutoCAD Release.</p> <p>7.2. Name PC peripherals of AutoCAD and mention the system requirements.</p> <p>7.3. Interpret the use of AutoCAD in civil engineering drawings.</p> <p>7.4. Write procedures to start a new drawing in AutoCAD.</p> <p>7.5. Write procedures to open an existing Drawing.</p> <p>7.6. Draw screen layout of AutoCAD. Explain setting preferences in CAD.</p>
8.	AutoCAD commands	<p>8.1. Use and write the syntax of different drawing commands.</p> <p>8.2. Use and write the syntax of different modify commands.</p>
9.	Features	<p>9.1. Explain view tools and inquiry commands.</p> <p>9.2. Understand Layers concept and write syntax of match properties and change properties.</p> <p>9.3. Write the syntax of measure and divide commands.</p> <p>9.4. Write the syntax of Block, Wblock and external reference command.</p> <p>9.5. Define Plotters/Printers. Write the procedure of plotting the drawing, Compare plotter and printer.</p>

3. 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> <p>1.6.1. Purpose of ceiling</p>	12

		<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 Superstructure	<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> <p>4.8. Bulking of sand</p>	10

		<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>3.12.1 Steel reinforcement</p> <p>3.12.2 Introduction and Advantages of R.C.C.</p> <p>3.12.3 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> <p>7.5. Opening an existing Drawing</p> <p>7.6. Screen layout of AutoCAD, Setting preferences</p>	6

		(Setting Units and Scale, managing drawing area by using Multi-View Setup and Limits.)	
8.	AutoCAD commands	8.1. Drawing Commands 1.1.1 Co-ordinate input methods (directive, absolute, relative and polar) 1.1.2 Point, Lines, Polyline, Multiline, Construction Lines 1.1.3 Circle, Arc, Ellipse, Donut 1.1.4 Polygon, Rectangle, Spline, solids 1.1.5 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 Superstructure	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	8.1 Practice different drawing commands, modify	5

	commands	commands.	
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
6	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	redit 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	6																	5

	Drafting Concept																		
7	Introduction to AutoCAD course and hardware	6																	5
8	AutoCAD commands	8																	6
9	Features	4																	3
	Total	64	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	50

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 geometric 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.

		<p>3.4 Explain Sight distance and its types.</p> <p>3.5 Numerical practice on Extra widening and sight distance.</p>
4	Highway materials	<p>4.1 Describe Importance of soil engineering in road construction.</p> <p>4.2 Explain Grading for road construction.</p> <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	<p>7.1 Describe Embankment construction.</p>

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

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	1.1 Importance of soil engineering in road construction 1.2 Grading for road construction 1.3 Sub-grade soil, its importance and requirements for practical use	5

		1.4 Stone aggregates, types and requirements 4.5 Binding materials uses and requirements	
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 pavement 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 6.6 Transporting equipment 6.7 Watering equipment 6.8 Rock excavation machinery 6.9 Production of aggregates	10
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 10.1.4 Surface Drainage, Embankments, Side slopes 10.1.5 Right of Way , Lateral and vertical clearances	2
		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 10		
	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. 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	8

		<p>equipment</p> <p>6.4 Arrange a field trip to illustrate road equipment in governmental / non-governmental construction institutions.</p> <p>6.5 Arrange field trips to observe the operation of road equipment at the time of construction in nearby locations.</p>	
7	Road construction technology	<p>7.1 Sensitize different types of road construction technology</p> <p>7.2 Set out road embankment</p>	7
8	Hill roads	<p>8.1 Draw free hand sketch of hill road with elements</p> <p>8.2 Arrange a field trip to visit and observe hill road elements.</p>	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
6	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	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	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	10																	8

	pavement and Road making machinery with its uses																		
7	Road construction technology	8																	6
8	Low cost roads	4																	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:

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

		<p>2.7 Unit of Measurement</p> <p>2.8 Unit Conversion</p> <p>2.9 Conversion Table for Important Units</p> <p>2.10 Chain and Tape corrections – Temperature Correction, Pull Correction, Sag 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>
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> <p>6.10 Curvature and refraction correction</p> <p>6.11 Plotting-longitudinal section, cross sections</p> <p>6.12 Errors in leveling-instrumental error, personal error, natural error</p> <p>6.13 Numerical practice</p>
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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 2.8 Unit of Measurement	10

		<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</p>	10

		<p>Line Field Book</p> <p>4.10 Conventional Symbols</p> <p>4.11 Procedure of Plotting a Chain Survey</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 Bearing- 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 Method of elimination of local attraction</p> <p>5.12 Calculation of Angles from Bearings</p> <p>5.13 Calculation of Bearings from Angles</p> <p>5.14 Sources of error in compass survey</p> <p>5.14 Numerical practice</p>	15
6	Leveling	<p>2.1 Definitions of the terms used in Leveling – Leveling, Datum, Bench Mark (Permanent,</p>	16

		<p>Temporary, Arbitrary), Reduced Level, Line of Collimation, Back Sight, Fore Sight, Intermediate Sight, Change Point or Turning Point</p> <p>2.2 Principle of Leveling – Simple Leveling, and Differential Leveling</p> <p>2.3 Types of Level – Dumpy Level, Tilting Level, Automatic Level</p> <p>2.4 Temporary Adjustment of Level – Setting up the Level, Leveling up, Elimination of Parallax (Focusing the Eye-piece, Focusing the Objective)</p> <p>2.5 Booking and Reduction of Levels– Rise and Fall Method, and Height of Instrument Method</p> <p>2.6 Uses of Leveling – Longitudinal Sections, Cross Sections, Contouring, Setting out Levels</p> <p>2.7 Two Peg Test</p> <p>2.8 Fly Leveling</p> <p>2.9 Reciprocal Leveling</p> <p>2.10 Curvature and Refraction Correction</p> <p>2.11 Plotting - Longitudinal Sections, Cross Sections</p> <p>2.12 Errors in Leveling – Instrumental Error, Personal Error, Natural Error</p> <p>2.13 Numerical Practice</p>	
	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 10		
	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 2.6 Perform and Compute Chain and Tape corrections – Temperature Correction, Pull Correction, Sag Correction	7
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	15

		<p>4.3 Perform Offsets – Perpendicular Offsets, Oblique Offsets</p> <p>4.4 Record Field Book – Single Line Field Book and Double Line Field Book</p> <p>4.5 Perform chain triangulation and detailing</p>	
5	Compass Survey	<p>5.1 Introduce Principle of Operation of Compass – Prismatic Compass, and Surveyor’s Compass</p> <p>5.2 Practice Comparison between Prismatic Compass and Surveyor’s Compass</p> <p>5.3 Practice Bearing System - Whole Circle Bearing System, and Quadrantal Bearing System</p> <p>5.4 Practice Fore Bearing and Back Bearing</p> <p>5.5 Determine and Compute Local Attraction</p> <p>5.6 Perform Compass Traversing and detailing</p> <p>5.7 Perform Reconnaissance Survey – Preparation of Index Sketch, Selection of Survey Stations, Location Sketch of Survey Stations</p> <p>5.8 Practice Calculation of Angles</p> <p>5.9 Practice Calculation of Bearings</p> <p>5.10 Perform Procedure of Plotting a Compass Survey</p>	14
6	levelling	<p>6.1 Perform leveling</p> <p>6.2 Two peg test</p> <p>6.3 Fly leveling</p> <p>6.4 Profile leveling and cross sectioning</p> <p>6.5 Reciprocal levelling</p>	16
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
6	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 : **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
	Total	64																	7

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 3.8 Draw reinforcement details of simple beam, lintel, column & slab 3.9 Find out reinforcement spacing, bends, hooks and development length 3.10 Estimate simple RCC works 3.11 Define plastering, punning & pointing works 3.12 Estimate plastering, pointing & punning works 3.13 Draw one, two, & multi room building (plan, elevation, section)
4	Rate Analysis	4.1 Define rate analysis 4.2 Write GON norms and current district rates 4.3 Define overhead, water charge, tools and plants, profit and vat. 4.4 Define man and materials consumption 4.5 Practice ratios of PCC in practice 4.6 Calculate dry volume and wet volume of ingredients 4.7 Draw structure drawing showing steel reinforcement 4.8 Prepare rate analysis of reinforcement bar 4.9 Calculate brick work for cubic meter work 4.10 Practice ratios in mortars (1:4, 1:6)
5	Quotation and tender	5.1 Define quotation and tender 5.2 Define quotation and tender documents

	documents	<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>8.3 Define supervision and supervisor's roles</p> <p>8.4 Write duties of supervisor</p> <p>8.5 Discuss interrelationship among client, consultant and contractors</p>
7	Construction site management	<p>7.1 Draw major components of construction site (site office, store, fabrication yard, worker accommodation, toilets)</p> <p>7.2 Define site logistics</p> <p>7.3 Define site utilities (telephone, water supply, electricity)</p> <p>7.4 Define surface drainage and sanitation</p> <p>7.5 Define site safety</p>
8	Prepare log book & muster roll	<p>8.1 Define Log book and its uses</p> <p>8.2 Prepare Format of log book</p> <p>8.3 Define Muster roll</p> <p>8.4 Write types of workers</p>
9	Measurement book & billing process	<p>9.1 Define measurement book</p> <p>9.2 Write about importance of M.B.</p> <p>9.3 Write Size of MB</p> <p>9.3 Definite bill of quantities (BOQ)</p> <p>9.5 Definite abstract of cost</p> <p>9.6 write procedure of running bill payment</p>
10	Layout work	<p>10.1 Write procedure for the layout of the building.</p> <p>10.2 Write equipment required for building layout</p> <p>10.3 Preparation before layout</p>

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 2.2 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	20

		3.13 Draw & estimate two, & multi room building (plan, elevation, section) *arrange field trip to familiar foundation, superstructure, culvert etc.*	
4	Rate Analysis	5.3 Define rate analysis 5.4 GON norms and current district rates 5.5 Define overhead, water charge, tools and plants, profit and VAT. 5.6 Man and materials consumption 5.7 Ratios of PCC in practice (1:3:6, 1:2:4) 5.8 Calculations of dry volume and wet volume of ingredients 5.9 Rate analysis of E/W, PCC, Form works, Plastering, reinforcement bar etc. 5.10 Calculations of a cubic meter of brick work 5.11 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	5

		7.3 Site utilities (telephone, water supply, electricity) 7.4 Surface drainage and sanitation 7.5 Site safety	
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	<p>3.1 Prepare working drawing, Write job specification, Prepare format for estimate and Practice on different methods of filling up the format</p> <p>3.2 Prepare working drawing and job specification, Calculate quantity for masonry work.</p> <p>3.3 Prepare working drawing and job specification, Estimate quantity of wall, Estimate quantity to be deducted.</p> <p>3.4 Prepare working drawing and job specification, Estimate quantity of concrete flooring works.</p> <p>3.5 Prepare working drawing and job specification, Estimate the quantity of steel and concrete for simple beam, lintel column and slab.</p> <p>3.6 Prepare drawing and job specification, Estimate the quantity of plastering/ punning/ pointing</p> <p>3.7 Prepare drawing and job specification, Estimate quantity of roofing sheet</p> <p>3.8 Prepare working drawing and job specification, Estimate a single roomed building, Estimate a double roomed building, Estimate a multi roomed building</p> <p>3.9 Prepare a working drawing and job specification, Estimate the quantity break pressure tank</p> <p>3.10 Prepare a working drawing and job specification, Estimate the quantity tap stand</p> <p>3.11 Prepare longitudinal and cross sectional profile,</p>	24

		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	4.11 Analyze rate for different job specifications as per NG norms in earthwork excavation 4.12 Analyze rate for PCC works in 1:2:4 for slab, beam and column. 4.13 Analyze rate for steel reinforcement in RCC works 4.14 Analyze rate for brick work of wall thickness half brick, one brick and one and half brick 4.15 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
7	Construction site management	7.1 Prepare the layout of construction site showing major components.	5
8	Prepare log book & muster roll	8.1 Prepare Muster roll format, Practice on entering the Muster roll	5
9	Measurement book & billing process	9.1 Prepare measurement book, Practice on entering data on MB 9.2 Prepare running bills.	5
10	Layout work	10.1 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
6	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																	2
2	Area and volume calculation	4																	3
3	Estimate quantity of masonry footings & super structure wall	20	7	1	0	2	2	1	0	2	1	9	5	2	16	9	25	16	16
4	Rate Analysis	10																	8
5	Quotation and tender documents	4																	3
6	Supervision works	4																	3
7	Construction site	5																	4

	management																		
8	Prepare log book & muster roll	5																	4
9	Measurement book & billing 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