CURRICULUM

DIPLOMA
Civil Engineering

(Specialized in Hydropower Engineering)

(Three Year's Program - Semester System)

Council for Technical Education and Vocational Training

Curriculum Development and Equivalence Division

Sanothimi, Bhaktapur

2017

First Revised 2022

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Introduction

Civil Engineering (Specialized in Hydropower Engineering) is one of the prominent disciplines in engineering sector. Many people in the developed countries, developing countries and under developed countries have emphasized for the broader application of Civil and Hydropower Engineering. This has been helping the world for the all-round physical infrastructure development and it has been creating wage and self-employment opportunities both in public and private sectors. This curriculum is based on the academic requirements to enter bachelor as well as designed with the purpose of producing middle level technical workforce equipped with knowledge and skills related to the field of civil engineering, especially in hydropower engineering so as to meet the demand of such workforce in the country to contribute in the national infrastructure development in the country. The knowledge and skills incorporated in this curriculum will be helpful to deliver the individual needs as well as national and international needs in the field of hydropower sector.

This course is based on the job required to perform by the Civil and Hydropower Engineering Technical workforce (Civil/Hydropower Sub-Engineer) at different levels of public and private sectors for physical infrastructures development. There are six semesters in total in three year's course duration. The first year course focuses on foundational and core subjects of Engineering; the second year course focuses on basic disciplinary subjects of Civil Engineering and Hydropower Engineering. Similarly, the third year whole courses comprise of the disciplinary subjects including provision of elective subjects. Moreover, the third year insists on the application of learned skills and knowledge through the minor project and major project.

The foundational subjects like Physics, Chemistry and Mathematics are offered in diffusion model of curricular programme. It also includes language subjects like Nepali and English applicable for the communication in the same area. The disciplinary subjects of Hydropower Engineering are offered in this programme are included in all semesters. This curricular programme also makes provision of project works as well as elective subjects in the specific areas of Hydropower Engineering. The curriculum structure and the subject wise content that reflect the details of this curriculum. In brief, this curriculum will guide to its implementers to produce competent and highly employable technical workforces in the field of civil/hydropower engineering.

Rationale of Revision

Diploma in Civil Engineering (Specialized in Hydropower Engineering) curriculum was developed in 2017. This is the first revision after the implementation of its development. The rationales behind its revision are as follows:

- It crossed the 5 years maturity period of its implementation after the development and similarly the implementing agencies/college have requested to revise this curriculum based on their teaching experiences.
- The year-wise re-adjustments of the existing subjects are felt necessary.
- Some new subjects seem to be introduce as per the advancement in technology.
- Its weightage is revised in both theory and practical marks and contents to make it more practical oriented.
- The technologies invented in the field of Mechanicl are necessary to incorporated.

Furthermore, technology of Mechanical occupation upgraded rapidly and new technology are introducing in the recent year. With the advent in technology trained technicians are needed throughout the world. To cope with the national and international demand, the knowledge and the

skills should be updated to make the skills relevant and pertinent to the industry. Hence this curriculum is revised to equip the students as per the changing technology in changing environmental context.

Curriculum title
Diploma in Civil Engineering (Specialized in Hydropower Engineering)

Aim
The program aims to produce mid-level technical human resource equipped with knowledge and skills in allied field of study.

Objectives
This program has following objectives to:

- Prepare mid-level competent workforce in the related field.
- Prepare technicians capable of undertaking Hydropower Engineering works under Road, Irrigation, Water supply, Building Construction and Hydropower infrastructures development.
- Fulfill the demand of required Hydropower Engineering Technicians for the public and private infrastructure development sector of Nepal.
- Prepare technical workforce demonstrating positive attitude and respect for the profession and socio-cultural values.
- Reduce the dependency on foreign technicians.
- Create self-employment opportunities.

Group Size
The group size is a maximum 48 students.

Entry Criteria

- SLC pass or SEE or equivalent with minimum C Grade (2.0 Grade Point) in Mathematics and Science and 1.6 Grade Point or equivalent in English and as per the provisions mentioned in the admission guidelines of Office of the Controller of Examinations, CTEVT.
- Pre-diploma in related subject or equivalent with minimum 68.33%.
- Pass entrance examination administered by CTEVT.

Duration
The total duration of this curricular program is three academic years [six semesters]. The program is based on semester system. Moreover, one semester consists of 19.5 academic weeks including evaluation period. Actual teaching learning Hrs. will be not less than 15 weeks in each semester.

Medium of Instruction
The medium of instruction will be in English and/or Nepali.

Pattern of Attendance
Minimum of 90% attendance in each subject is required to appear in the respective final examination.

Teacher (Instructor) and Student Ratio

The ratio between teachers and students must be:

- Overall ratio of teacher and student must be 1:12 (at the institution level)
  - 1:48 for theory and tutorial classes
  - 1:12 for practical classes
  - 1:8 for bench work
  - 75 % of the technical teachers should be full timer

Qualification of Instructional Staff

- The program coordinator should be a master's degree holder in the related subject area.
- The disciplinary subject related teachers should be a bachelor's degree holder in the related subject area.
- The demonstrators should be a bachelor's degree holder or diploma or equivalent with 3 years work experience in the related subject area.
- The foundational subject related teacher (refer to course codes SH and MG) should be master's degree holder in the related subject area.

Instructional Media and Materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- ***Printed media materials:*** Assignment sheets, case studies, handouts, performance checklists, textbooks etc.
- ***Non-project media materials:*** Displays, models, photographs, flipchart, poster, writing board etc.
- ***Projected media materials****:* Slides, Multimedia Projector.
- ***Audio-visual materials:*** Audiotapes, films, slide-tapes, videodisc, etc.
- ***Computer based instructional materials:*** Computer based training, interactive video etc.
- **Web-Based Instructional Materials** (Online learning)
- **Radio/Television/Telephone**
- **Education-focused social media platform**

Teaching Learning Methodologies

The methods of teachings for this curricular program will be a combination of several approaches such as; illustrated lecture, tutorial, group discussion, demonstration, simulation, guided practice, fieldwork, block study, industrial practice, report writing, term paper presentation, heuristic and other independent learning exercises.

- **Theory**: Lecture, Group discussion, assignment and group work etc.
- **Practical**: Demonstration, observation and self-practice.
- **Internship**: Industrial Practice.

Approach of Learning

There will be inductive, deductive and learner-centered approaches of learning.

Examination and Marking Scheme

a. Internal assessment

- There will be a transparent/fair evaluation system for each subject both in theory and practical exposure.
- Each subject will have internal assessment at regular intervals and students will get the feedback about it.
- Weightage of theory and practical marks are mentioned in course structure.
- Continuous assessment format will be developed and applied by the evaluators for evaluating student's performance in the subjects related to the practical experience.

b. Final examination

- Weightage of theory and practical marks are mentioned in structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject s/he will appear in the re-examination administered by CTEVT.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

c. Requirement for final practical examination

- Professional of relevant subject instructor must evaluate final practical examinations.
- One evaluator in one setting can evaluate not more than 24 students.
- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned or affiliating institute led by external evaluator nominated by CTEVT. Question setting for final practical exam also is done by Office of the Controller of Examinations (OCE), CTEVT.
- Provision of re-examination will be as per CTEVT policy.

d. Final practicum evaluation will be based on

- Institutional practicum attendance - 10%
- Logbook/Practicum book maintenance - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%
- Viva voce:
  - Internal examiner - 20%
  - External examiner - 20%

e. Pass marks

- The students must secure minimum 40% marks in theory and 50% marks in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

Provision of Back Paper

There will be the provision of back paper but a student must pass all the subjects of all year within six years from the enrollment date; however, there should be provision of chance exam for final year students as per CTEVT rules.

Disciplinary and Ethical Requirements

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by the review of the disciplinary review committee of the institute.
- Dishonesty in academic or practical activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

Grading System

The following grading system will be follows:

	Grading	**Overall marks**
•	Distinction:	80% and above
•	First division:	65% to below 80%
•	Second division:	50 % to below 65%
•	Pass division:	Pass marks to Below 50%

Certificate Awarded

- Students who pass all the components of all subjects of all six semesters are considered to have successfully completed the course.
- Students who have successfully complete the curricular program will be awarded with a degree of **"Diploma in Civil Engineering (Specialized in Hydropower Engineering)"**.

Career Path

The graduates will be eligible for the position equivalent to Non-gazetted 1st class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies.

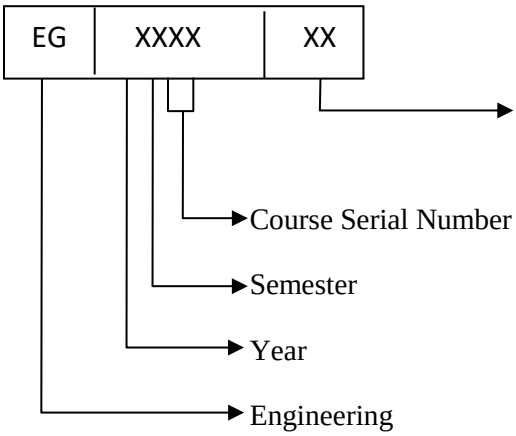
General Attitudes Required

A student should demonstrate following general attitudes for effective and active learning.

Acceptance, Affectionate, Ambitious, Aspiring, Candid, Caring, Change, Cheerful, Considerate, Cooperative, Courageous, Decisive, Determined, Devoted, Embraces, Endurance, Enthusiastic, Expansive, Faith, Flexible, Gloomy, Motivated, Perseverance, Thoughtful, Forgiving, Freedom, Friendly, Focused, Frugal, Generous, Goodwill, Grateful, Hardworking, Honest, Humble, Interested, Involved, Not jealous, Kind, Mature, Open minded, Tolerant, Optimistic, Positive, Practical, Punctual, Realistic, Reliable, Distant, Responsibility, Responsive, Responsible, Self-confident, Self-directed, Self-disciplined, Self-esteem, Self-giving, Self-reliant, Selfless, Sensitive, Serious, Sincere, Social independence, Sympathetic, Accepts others points of view, Thoughtful towards others, Trusting, Unpretentiousness, Unselfish, Willingness and Work-oriented.

Subjects codes

Each subject is coded with a unique number preceded and followed by certain letters as mentioned in following chart:



Code of Offering Diploma Programmes:

1. AGE: Agricultural Engineering
2. AR: Architecture Engineering
3. AE: Automobile Engineering
4. BM: Biomedical Engineering
5. BM: Biomedical Equipment Engineering
6. CE: Civil Engineering
7. CT: Computer Engineering
8. EE: Electrical Engineering
9. EEX: Electrical & Electronics Engineering
10. EX: Electronics Engineering
11. GE: Geomatics Engineering
12. HE: Hydropower Engineering
13. IT: Information Technology
14. MG: Management
15. ME: Mechanical Engineering
16. MX: Mechatronics Engineering
17. RAE: Refrigeration & Air Conditioning Engineering
18. SH: Science and Humanities

CURRICULUM STRUCTURE

Diploma in Civil Engineering (Specialized in Hydropower Engineering)

YEAR: I **PART I**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 1101 SH	Applied Nepali	4				4	4	20	80	3				100	*Continuous assessment
2	EG 1102 SH	Applied English	4				4	4	20	80	3				100	
3	EG 1103 SH	Engineering Mathematics I	4	2			6	4	20	80	3				100	
4	EG 1104 SH	Engineering Physics I	4	2		2	8	5	20	60	3	10	10	2	100	
5	EG 1105 SH	Engineering Chemistry I	4	2		2	8	5	20	60	3	10	10	2	100	
6	EG 1101 AR	Engineering Drawing I	1		4		5	3				60	40	4	100	
7	EG 1101 CT	Computer Application	2		2		4	3	10	40	1.5	30	20	3	100	
		TOTAL	**17**	**8**	**10**	**5**	**40**	**28**							**700**	

YEAR: I **PART II**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 1201 SH	Engineering Mathematics II	4	2			6	4	20	80	3				100	*Continuous assessment
2	EG 1202 SH	Engineering Physics II	4	2		2	8	5	20	60	3	10	10	2	100	
3	EG 1203 SH	Engineering Chemistry II	4	2		2	8	5	20	60	3	10	10	2	100	
4	EG 1201 CE	Workshop Practice I	2		6		8	5	0	0		60	40	4	100	
5	EG 1201 AR	Engineering Drawing II	0		4		4	2	0	0		60	40	4	100	
6	EG 1202 CE	Applied Mechanics	3	2		2/2	6	4	20	60	3	20	0		100	
		TOTAL	**17**	**8**	**10**	**5**	**40**	**25**							**600**	

Diploma in Civil Engineering (Specialized in Hydropower Engineering)

YEAR: II **PART I**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Exam Hours	*Assmt Marks	Final Marks	Exam Hours		
1	EG 2101 HE	Engineering Mathematics III	3	1			4	3	20	80	3				100	*Continuous assessment
2	EG 2102 HE	Surveying I	3		5		8	6	20	80	3	100	50	4	250	
3	EG 2103 HE	Engineering Materials	5			2/2	6	6	20	80	3	25			125	
4	EG 2103 CE	Fluid Mechanics and Hydraulics	3	1		2/2	5	4	20	80	3	25			125	
5	EG 2104 HE	Mechanics of Structure	4	2		2/2	7	5	20	80	3	25			125	
6	EG 2105 HE	Workshop Practice II	3		4		7	5	20	80	3	60	40	4	200	
7	EG 2106 HE	Engineering Geology	2			2/2	3	3	10	40	3	25			75	
TOTAL			**23**	**4**	**9**	**4**	**40**	**32**							**1000**	

YEAR: II **PART II**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Time Hours	*Assmt Marks	Final Marks	Time Hours		
1	EG 2201 HE	Basic Electrical Engineering	3			3	6	5	20	80	3	50			150	*Continuous assessment
2	EG 2202 HE	Building Construction	5	1		2	8	6	20	80	3	25			125	
3	EG 2203 HE	Surveying II	3		4		7	5	20	80	3	60	40	4	200	
4	EG 2204 HE	Estimating and Costing I	3			4	7	5	20	80	3	50			150	
5	EG 2205 HE	Soil Mechanics and Foundation Engineering	4	2		2/2	7	5	20	80	3	25			125	
6	EG 2206 HE	Hydrology and Irrigation	3	1		2/2	5	4	20	80	3	25			125	
TOTAL			**21**	**4**	**4**	**11**	**40**	**30**	**120**	**480**					**875**	

Diploma in Civil Engineering (Specialized in Hydropower Engineering)

YEAR: III **PART I**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Time Hours	*Assmt Marks	Final Marks	Time Hours		
1	EG 3101 HE	CAD and Construction Drawing	1		4		5	3				100	50	4	150	*Continuous assessment
2	EG 3102 HE	Estimating and Costing II	3			3	6	5	20	80	3	50			150	
3	HE 3103 HE	Structural Design and Drawing	5	3		2	10	6	20	80	3	25			125	
4	EG 3104 HE	Transportation Engineering	3			2/2	4	4	20	80	3	25			125	
5	EG 3105 HE	Water Supply and Sanitary Engineering	3	1		2/2	5	4	20	80	3	25			125	
6	EG 3106 HE	Hydropower Engineering I	4	1		2/2	6	5	20	80	3	25			125	
7	EG 3107 HE	Minor Project (Survey Camp)			4		4	2				60	40	4	100	
TOTAL			**19**	**5**	**8**	**8**	**40**	**29**	**100**	**400**		**310**	**90**		**900**	

YEAR: III **PART II**

S.N	Code No.	Subjects	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hrs	Credit Hrs	DISTRIBUTION OF MARKS							
									Theory			Practical				
			L	T	P	Lab			*Assmt Marks	Final Marks	Time Hrs	*Assmt Marks	Final Marks	Time Hrs		
1	EG 3201 MG	Entrepreneurship Development	3		2		5	4	20	60	3	10	10	2	100	*Continuous assessment
2	EG 3201 HE	Construction Management	4	1			5	4	20	80	3				100	
3	EG 3202 HE	Estimating and Costing III	3			3	6	5	20	80	3	50			150	
4	EG 3203 HE	Hydropower Engineering II	4	2		2	8	5	20	80	3	25			125	
5	EG 3204 HE	Major Project			10		10	5				150	100	6	250	
6		Elective (One of the followings)	3			3	6	5	20	80		50			150	
	EG 3205 HE.1	a: Micro Hydropower														
	EG 3205 HE.2	b: Hydropower Structure														
	EG 3205 HE.3	c: Energy Management														
	EG 3205 HE.4	d. Basics of Graphic Information System (GIS)														
TOTAL			**17**	**3**	**12**	**8**	**40**	**28**							**875**	

L=Lecture, T=Tutorial, P=Practical

First Year (First and Second Semester)

[See Separate Curriculum]
First Year Engineering All
(Year I Part I and Year I Part II)

Second Year
(Third and Fourth Semesters)

Third Semester
Year II Part I

Subjects:

1. EG 2101 HE Engineering Mathematics III
2. EG 2102 HE Surveying I
3. EG 2103 HE Engineering Materials
4. EG 2103 CE Fluid Mechanics and Hydraulics
5. EG 2104 HE Mechanics of Structure
6. EG 2105 HE Workshop Practice II
7. EG 2106 HE Engineering Geology

Engineering Mathematics III

EG 2101 HE

Year: II **Total: 4 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: Hrs/week

Course Description:
This course consists of five units namely: Applications of derivatives, Partial derivatives, application of Anti-derivatives, Differential equations and application of differential equation using FEM; which are basically necessary to develop mathematical knowledge and helpful for understanding as well as practicing their skills in the related engineering fields.

Course Objectives:
On completion of this course, students will be able to understand the concept of the following topics and apply them in the related fields of different engineering areas: Applications of derivatives and anti-derivatives, Partial derivatives, differential equations and its application using FEM.

Course Contents:

Unit 1: Applications of Derivatives **[12 Hrs]**

1.1 Derivatives of inverse circular functions and hyperbolic functions
1.2 Differentials, tangent and normal
1.3 Maxima and minima, concavity, increasing and decreasing functions
1.4 Rate measures
1.5 Indeterminate forms: $\frac{0}{0}$, $\frac{\infty}{\infty}$ and $\infty - \infty$, L'Hospital's Rule (without proof)

Unit 2: Partial Derivatives **[6 Hrs]**

2.1 Functions of more than two variables
2.2 Partial derivative from First principles
2.3 Partial derivatives of First and higher orders
2.4 Euler's theorem for function of two variables
2.5 Partial derivatives of composite functions

Unit 3: Applications of Anti-Derivatives **[8 Hrs]**

3.1 Standard Integrals, related numerical problems
3.2 **Basic idea of curve sketching:** odd and even functions, periodicity of a function, symmetry (about *x*-axis, *y*-axis and origin), monotonicity of a function, sketching graphs of polynomial, trigonometric, exponential, and logarithmic functions (simple cases only)
3.3 Area under a curve using limit of sum (without proof)
3.4 Area between two curves (without proof)
3.5 Area of closed a curve (circle and ellipse only)

Unit 4: Differential Equations **[14 Hrs]**

4.1 Ordinary Differential Equations (ODEs)

- Definitions, order and degree of differential equation
- Differential equation of First order and First degree
- Variable separation and variable change methods
- Homogeneous and linear differential equation of First order
- Exact differential equation, condition of exactness
- Simple applications of First order differential equations

4.2 Partial Differential Equations (PDEs)

- Basic concepts, definition and formation
- General solution of linear PDEs of first order (Pp + Qq = R form)

Unit 5: Application of Differential Equation Using Finite Element Method [5 Hrs]

5.1 Basic terminologies in FEM
5.2 Engineering application of FEM
5.3 Application of First order differential equations using FEM
5.4 Application of Second order differential equations using FEM

Tutorial: ***[15 Hrs]***

1. Applications of Derivatives [4 Hrs]
2. Partial Derivatives [2 Hrs]
3. Applications of Anti-derivatives [3 Hrs]
4. Differential Equations [5 Hrs]
5. Application of differential equations using FEM [1 Hrs]

References:

1. Thapa et al., "Engineering Mathematics-Volume I, Three Years Diploma", Sukunda Pustak Bhawan, Bhotahity, Kathmandu, Nepal
2. Bajracharya et al., "Basic Mathematics-Grade XI/XII", Sukunda Pustak Bhawan, Bhotahity, Kathmandu, Nepal
3. Kryszig E., "Advanced Engineering Mathematics", Wile-Easter Publication, New Delhhi, India
4. Nath et al., "Engineering Mathematics III", Vidhyarthi Publisher & distributors, Kathmandu, Nepal
5. Chennakesava R. Alavala, "Finite Element Methods and Basic concepts and Applications", PHI Learning Private Limited, New Delhi,

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Applications of Derivatives	12	20
2	Partial Derivatives	6	12
3	Applications of Anti-Derivatives	8	18
4	Differential Equations	14	24
5	Application of Differential Equation Using Finite Element Method	5	6
Total		**45**	**80**

Note: There might be minor deviations in above specified marks.

Surveying I
EG 2102 HE

Year: II **Total: 8 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: 5 Hrs/week
Lab: Hrs/week

Course description:
This course focuses on familiarization on different surveying techniques and handling of surveying equipment. The different surveying techniques include linear, angular, vertical measurements, and plotting skills.

Course objectives:
After the completion of this course, students will be able to:
1. Apply distance measurement techniques and
2. Use basic surveying techniques and plotting of plan and map.

Course Contents:

Unit 1: Introduction **[4 Hrs]**
- 1.1 History and definition of surveying
- 1.2 Primary division of survey
- 1.3 Classifications according to discipline, nature and instruments used
- 1.4 Principles of surveying
- 1.5 Definition of accuracy, precision
- 1.6 Error: Types and sources
- 1.6 Scale: Map scale, Measuring Scale

Unit 2 Linear Measurement **[6 Hrs]**
- 2.1 Different methods of direct and indirect distance measurement
- 2.2 Equipment for direct chaining and taping
- 2.3 Ranging and its methods
- 2.4 Chaining on horizontal and sloping ground by direct and indirect methods
- 2.5 Errors in chaining and precision ratio
- 2.6 Various corrections for linear distance measurement
- 2.7 Error and correction for Tape
- 2.8 Field procedures and problems

Unit 3 Chain Surveying **[4 Hrs]**
- 3.1 Introduction
- 3.2 Principles of chain surveying
- 3.3 Procedures of chain surveying
  - 3.3.1 Reconnaissance
  - 3.3.2 Selection and marking of survey stations and survey lines
  - 3.3.4 Detailing

3.4 Obstacles in chaining and taping
3.5 Plotting and field problems

Unit 4: Compass Traversing **[8 Hrs]**

4.1 Introduction
4.2 Technical terms
4.3 System of bearings, fore and back bearing
4.4 Prismatic and Surveyor's compass
4.5 Calculation of angles from bearing and bearing from angles, angular precision
4.6 Magnetic declination, local attraction, detection and correction of local attraction
4.7 Error in compass survey and their adjustment
4.8 Field problems and procedures

Unit 5: Leveling **[12 Hrs]**

5.1 Definition and objectives
5.2 Classification of leveling according to principles – Simple leveling, and Differential leveling
5.3 Technical terms used in leveling
5.4 Instruments used in leveling
5.5 Temporary and permanent adjustment of level
5.7 Methods for booking and reducing of level
5.8 Classification of direct leveling
    5.8.1 Simple leveling
    5.8.2 Continuous or differential leveling
    5.8.3 Fly leveling
    5.8.4 Reciprocal leveling
    5.8.6 Profile leveling and cross sectioning
5.9 Errors in leveling and its adjustment
5.10 Field procedures, problems and plotting of graphs

Unit 6: Contouring **[6 Hrs]**

6.1 Definition - Contour interval, Horizontal equivalent, general contours, Index contour
6.2 Criteria for selection of contour interval
6.3 Characteristics of contours
6.4 Methods of contouring for contour survey
    7.4.1 Direct method
    7.4.2 Indirect method i.e. grid method, cross section method and radial method
6.5 Methods of interpolation of contours
6.6 Uses of contour maps
6.7 Field procedures and problems

Unit 7: Plane Tabling **[5 Hrs]**

7.1 Definition and principles
7.2 Accessories used in plane tabling
7.3 Working operations - temporary adjustment and orientation
7.4 Methods of plane tabling - Radiation, Intersection, Traversing and Resection (introduction only for resection)

7.5 Errors in plane table surveying
7.6 Merits and demerits of plane table surveying

Practical (Field work) ***[75 Hrs]***

1. Care and handle instruments. [5 Hrs]
2. Measure linear distance on plane and sloping ground. [5 Hrs]
3. Perform Chain triangulation and detailing. [10 Hrs]
4. Perform Compass traversing and graphical correction of angular misclosure. [15 Hrs]
5. Perform Leveling [20 Hrs]
    - 5.1 Two peg test
    - 5.2 Differential/fly leveling
    - 5.3 Profile leveling and cross sectioning
6. Plotting Contour Map [5 Hrs]
7. Plane table traverse, resection, intersection and detailing [15 Hrs]

Evaluation of Practical: Continuous evaluation (Viva + Instrumentation + Objective test)

References:

1. Dr. BC Punmia, " Surveying " Vol I and II, Laxmi Publication New Delhi
2. R. Agor ,"Surveying and Leveling", Khanna Publication New Delhi
3. SK Duggal, "Surveying" Vol I and II, Tata MC Graw Hill Publishing
4. N Basnet and M Basnet, "Basic Surveying – I", Benchmark Education Support Pvt. Ltd. Tinkune Kathmandu
5. N Basnet and M Basnet, "Basic Surveying –II", Published by D. Shrestha & R. Shrestha, Rajmati Press, Lalitpur
6. Dr. BC Punmia, " Surveying " Vol I and II, Laxmi Publication New Delhi

Marks Specification for final examination:

Unit		Course Hours	Marks
1	Introduction	4	6
2	Linear Measurement	6	12
3	Chain Surveying	4	6
4	Compass Traversing	8	16
5	Leveling	12	20
6	Contouring	6	12
7	Plane Tabling	5	8
Total		**45**	**80**

Note: There might be minor deviation on the above specified marks

Engineering Materials

EG 2103 HE

Year: II **Total: 6 Hrs/week**
Part: I **Lecture: 5 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:

This course is designed to help students on using various construction materials in civil construction works.

Course objectives:

After the completion of this course, students will be able to:

1. Recognize various construction materials that are essential in construction;
2. Select the quality materials for the use in construction;
3. Test materials for quality, strength and durability and
4. Use materials in their proper field and state.

Course Contents:

Unit 1: Stones **[10 Hrs]**

- 1.1 Introduction to stones as building units
- 1.2 Stones as various forms of engineering materials
- 1.3 Formation of rocks and its classification
- 1.4 Geological classification of stones
- 1.5 Availability of stones in Nepal
- 1.6 Physical and Chemical properties of stones
- 1.7 Quarrying of stones – Excavation, wedging and blasting,
- 1.8 Blasting of stones – Precautions
- 1.9 Preparing building units from stones- Dressing and seasoning.
- 1.10 Testing of stones for-
  - 1.10.1 Weathering
  - 1.10.2 Durability,
  - 1.10.3 Water absorption and porosity,
  - 1.10.4 Specific gravity,
  - 1.10.5 Compressive strength
- 1.11 Characteristics of good building stones.

Unit 2: Bricks **[10 Hrs]**

- 2.1 Introduction
- 2.2 Classification
- 2.3 Brick earth: Composition of brick earth, functions of various constituent of brick earth, harmful constituents.

2.4 Preparation of brick earth for making bricks: digging, weathering, blending and tempering.
2.5 Moulding of bricks and various methods of moulding
2.6 Drying of moulded bricks
2.7 Burning of bricks: Intermittent and continuous kilns
2.8 Traditional method of brick burning
2.9 Tests of bricks: Compressive strength, Water absorption and Efflorescence.

Unit 3: Tiles **[6 Hrs]**

3.1 Types of tiles: Roofing tiles, wall tiles, clay pipes and uses in construction
3.2 Manufacturing of tiles
3.3 Properties of tiles

Unit 4: Lime **[8 Hrs]**

4.1 Introduction
4.2 Classification of limes: Fat Lime (white lime), Lean lime, and Hydraulic lime.
4.3 Setting action of lime
4.4 Manufacturing of lime
4.5 Raw materials, burning, slaking
4.6 Intermittent and continuous methods of manufacture
4.7 Testing of Limes: Visual examination test, acid test, ball test, impurity test and working test

Unit 5: Cement **[10 Hrs]**

5.1 Introduction
5.2 Uses of Cement in Construction
5.3 Raw materials (Ingredients) of Cement
5.4 Wet process of manufacturing
5.5 Flow diagram of wet process of manufacturing
5.6 Various types of cement and their properties
5.7 Storage and transportation
5.8 Various admixtures and bogue compounds
5.9 Standards test on Cement

Unit 6: Timber and Timber Products **[12 Hrs]**

6.1 Introduction
6.2 Definition and sources of timber
6.3 Classification of trees
6.4 Structure of tree, hard wood and soft wood and their characteristics,
6.5 Defects in timber
6.6 Seasoning of Timber, Objectives of Seasoning, Various methods of seasoning, Prevention of drying of logs, Preservation of Timbers,
6.7 Plywood, Lamina Boards, Block boards, Hard boards, Fiber boards

Unit 7: Metals and Alloys **[10 Hrs]**

7.1 Ferrous and Non-ferrous metals
7.2 Uses of different metals in construction
7.3 Occurrence of Iron: Pig iron

7.4 Properties and uses of:
- Cast iron
- Wrought iron

7.5 Comparison of wrought iron with cast iron in similar headings
7.6 Steel: Composition, properties and uses, different types of steels
7.7 Corrosion in ferrous metals
7.8 Protection of ferrous metals
7.9 Alloys: Aluminium alloys, copper alloys and bronzes: composition, properties and uses.

Unit 8: Paints and Varnishes **[5 Hrs]**

8.1 Introduction – Paints and Varnishes
8.2 Uses of Paints and Varnishes
8.3 Composition of various types of Paints: Oil paint, Water Paint, Cement paints and Acrylic paints
8.4 Methods of application of various paints

Unit 9: Miscellaneous Materials **[4 Hrs]**

9.1 Glass (Constituents, types, properties, applications and limitation in use)
9.2 Plaster of Paris
9.3 Insulation Boards
9.4 Prefabricated materials (gypsum board, sandwich panel)

Practical (Laboratory) ***[15 Hrs]***

1. Perform fineness test of cement
2. Perform consistency test of cement
3. Determine initial and Final setting time of cement
4. Perform compressive test of cement
5. Perform tensile test of cement

References:

1. S.S. Bhavikatti, "Building materials and construction"
2. S. Singh, " Engineering materials, Vikas publishing house pvt.ltd.
3. C.V.Y. Chong, "Properties of materials", MacDonald and evans ltd. estover, plymouth, UK
4. R. B. Gupta, "Material science and processes", Satya prakashan, inc. tech India publication, New Delhi.
5. Chinikaji Sthapit,"Engineering materials", Laxmi pustak Bhandar

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Stones	10	10
2	Bricks	10	10
3	Tiles	6	6
4	Lime	8	10
5	Cement	10	10
6	Timber and Timber Products	12	12
7	Metals and Alloys	10	10
8	Paints and Varnishes	5	6
9	Miscellaneous Materials	4	6
	Total	**75**	**80**

Note: There might be minor deviation on above specified marks.

Fluid Mechanics and Hydraulics

EG 2103 CE

Year: II **Total: 5 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:
This course focuses on the fundamental concepts and principles of Hydraulics, measurement of flow, and introduction to open channel flow and pipe flow.

Course Objectives:
After the completion of this course, students will be able to:

1. Understand the properties of fluid;
2. Analyze the behavior of fluid at rest;
3. Analyze the behavior of fluid in motion;
4. Apply the measurement techniques for pressure and discharge;
5. Understand the concept of head loss in pipe flow and
6. Understand the basic concept of open channel flow.

Course Contents:

Unit 1: Introduction to Fluid Mechanics and Hydraulics [3 Hrs]

1.1 Introduction: Fluid, Fluid Mechanics and Hydraulics
1.2 Properties of fluid (Definition, formula, unit and dimension): mass density, specific weight, specific volume, specific gravity, viscosity (Dynamic and kinematic viscosity), Newton's law of viscosity, surface tension, capillarity, compressibility and Bulk Modulus.
1.3 Difference between real and ideal fluid, Newtonian and Non-Newtonian fluid, Compressible and incompressible fluid.

Unit 2: Hydrostatics [10 Hrs]

2.1 Introduction to fluid pressure
2.2 Derivation for Pascal's law and pressure-depth relationship (Hydrostatic law)
2.3 Relationship of atmospheric pressure, Vacuum pressure, gauge pressure and absolute pressure
2.4 Measurement of pressure by piezometer and U-tube manometer
2.5 Definition of total pressure and center of pressure
2.6 Derivation for total pressure and center of pressure on horizontal, vertical and inclined plane submerged surface
2.7 Principle of floatation
2.8 Definition of Buoyancy and Archimedes' principle
2.9 Introduction to relative equilibrium

Unit 3: Hydro Kinematics **[5 Hrs]**

3.1 Types of flow: Steady and unsteady, uniform and non-uniform, laminar and turbulent, compressible and incompressible, rotational and irrotational, one, two and three dimensional
3.2 Reynold's number: Definition, equation and criteria for laminar and turbulent flow
3.3 Streamline: Definition, equation, characteristics
3.4 Conservation principles of mass, energy, momentum and continuity equation for one dimensional incompressible flow

Unit 4: Hydrodynamics **[3 Hrs]**

4.1 Energy of flowing fluid: potential or datum energy, kinetic energy, pressure energy
4.2 Concept of energy head
4.3 Bernoulli's theorem: Statements, assumptions, equation and applicability
4.4 Concept of Hydraulic gradient line (HGL) and energy gradient line (EGL)

Unit 5: Flow Measurement **[10 Hrs]**

5.1 Orifice: Definition and types, definition of vena-contracta
5.2 Derivation of equation for discharge through small orifice
5.3 Hydraulic coefficients of orifice: coefficient of discharge, velocity and contraction (definition, formula and experimental method of determination)
5.4 Concept of venturimeter, derivation of equation for discharge through venturimeter
5.5 Introduction to weir or notch and their classifications
5.6 Derivation of equation for discharge through rectangular, triangular and trapezoidal weir or notch
5.7 Area-velocity method for the discharge measurement in open channel (float and current meter): description of measurement technique, mid-section method for discharge computation

Unit 6: Pipe Flow **[6 Hrs]**

6.1 Introduction to pipe flow
6.2 Shear stress, Velocity profile for laminar and turbulent flow through pipes
6.3 Loss of head in pipes: introduction to major and minor loss such as entry, expansion, contraction, fitting, bend, obstruction, exit loss
6.4 Derivation of Loss of head in pipes in laminar (Hagen Poiseuille equation) and turbulent flow (Darcy-Weisbach equation)
6.5 Derivation of equation for expansion and contraction loss

Unit 7: Open Channel Flow **[8 Hrs]**

7.1 Difference between pipe flow and open channel flow
7.2 Types and classification of open channel flow: steady and unsteady, uniform and non-uniform, prismatic and non-prismatic, natural and artificial, (gradually varied, rapidly varied and spatially varied flow), laminar and turbulent, subcritical, critical and supercritical flow
7.3 Geometric elements of open channel (flow depth, depth of flow section flow area, top width, wetted perimeter, hydraulic radius, hydraulic depth, section factor, conveyance)
7.4 Velocity distribution in open channel flow
7.5 Chezy's equation and Manning's equation for the computation of velocity in uniform flow

7.6 Introduction to most efficient and economical section in open channel flow.
7.7 Energy equation and momentum equation in open channel flow
7.8 Specific energy: Definition, equation and diagram and Critical flow criteria, alternative depth, conjugate depth.

Tutorials: ***[15 Hrs]***

1. Numerical of fluid properties **[1 Hr]**
2. Pressure computation, Pressure measurement by piezometer and U-tube manometer, Total pressure and center of pressure for horizontal, vertical and inclined submerged surface, and the principle of floatation **[3 Hrs]**
3. Computation of discharge by using continuity equation, computation of Reynold's number, and identifying type of flow **[2 Hrs]**
4. Application of Bernoulli's equation with and without head loss, Draw HGL, and EGL **[1 Hr]**
5. Computation of hydraulic coefficients, and discharge through orifice, venturimeter, rectangular, triangular and trapezoidal weir, mid-section method for discharge computation **[3 Hrs]**
6. Computation of Shear stress, velocity and Head loss (Major and minor) computation in pipe flow **[2 Hrs]**
7. Computation of Cross-sectional properties, velocity, discharge and flow depth computation for uniform flow through an open channel, Critical flow parameters such as depth, velocity, energy, and alternative and conjugate depths **[3 Hrs]**

Practical/Laboratory ***[15 Hrs]***

1. Measure major (i.e. friction) and minor (Contraction, expansion) head losses in pipe
2. Measure pressure by piezometer and manometer
3. Verify Bernoulli's equation
4. Measure flow through orifice, notch
5. Experments on open canal flow

References:

1. D. P. Sangroula "Fundamentals of Fluid Mechanics', Nepal Printing Support, Anamnagar, Kathmandu
2. P.N. Modi and S. M. Seth "Fluid Mechanics and Hydraulics, Standard Book House
3. D.S. Kumar "Fluid Mechanics and Fluid power Engineering', S.K. Kataria and Sons
4. S. Ramamrutham 'Hydraulics fluid mechanics and fluid machines' Dhanpat Rai Publishing Company (P) Ltd. New Delhi.
5. R.K. Rajput, "Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd.
6. A.K. Upadhyay, "Hydraulics and Pneumatics", S.K. Kataria and Sons.
7. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd.

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Fluid Mechanics and Hydraulics	4	4
2	Hydrostatics	13	20
3	Hydro Kinematics	7	8
4	Hydrodynamics	4	4
5	Flow Measurement	13	16
6	Pipe Flow	8	12
7	Open Channel Flow	11	16
	Total	**60**	**80**

Note: There might be minor deviation on the above-specified marks.

Mechanics of Structure

EG 2104 HE

Year: II **Total: 7 Hrs/week**
Part: I **Lecture: 4 Hrs/week**
Tutorial: 2 Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:

This course is about structural analysis of statically determinate structures and properties of some materials used in structure. It is pre-requisite for design of simple structures.

Course Objectives:

After the completion of this course, students will be able to:

1. Identify stable and unstable and statically determinate and indeterminate structures;
2. Determine degree of static indeterminacy of statically indeterminate structures
3. Understand constitutive relation of some materials to be used in structures;
4. Analyze the simple determinate structures like truss, beam and frame, and
5. Analyze shaft and strut for torsion and axial load.

Course Contents:

Unit 1: Introduction: **[4 Hrs]**

1.1 Definition of mechanics of structure.
1.2 Review on types of loads, types of supports and reaction. Their symbolic representation.
1.3 Stability, determinacy, indeterminacy and degree of freedom of structure (beam, frame and truss)
1.4 Introduction to statically determinate and indeterminate structures
1.5 Determination of degrees of static indeterminacies.

Unit 2: Simple Stress and Strain: **[14 Hrs]**

2.1 Concepts of stress and strain
2.2 Linear stress and strain and their relation, Hooke's law and Young's modulus of elasticity.
2.3 Deformation of uniform bar due to axial load
2.4 Stress strain curves for different materials.
2.5 Ultimate strength and working stress of materials and factor of safety.
2.6 Factors affecting factor of safety.
2.7 Thermal stress.
2.8 Stress and strains in plain and composite bars.
2.9 Poisson's ratio, Shear stress, shear strain and modulus of rigidity.
2.10 Volumetric strain and Bulk modulus.
2.11 Relation between Young's modulus, Bulk modulus and modulus of rigidity.
2.12 Concept of Principle stresses, principle planes and shear stress

Unit 3: Axial Force, Shearing force and Bending Moment: **[12 Hrs]**

3.1 Review of Axial force, shear force and bending moment
3.2 Axial force, shear force and bending moment diagrams for statically determinate Beam under various types of loading.
3.3 Axial force, shear force and bending moment diagrams for statically determinate Plane frame under various types of loading.
3.4 Point of contra flexure.
3.5 Axial force analysis for statically determinate truss

Unit 4: Theory of Simple Bending: **[10 Hrs]**

4.1 Concept of bending and pure bending.
4.2 Assumptions in theory of simple bending.
4.3 Radius of curvature, neutral layer and neutral axis.
4.4 Stress due to bending.
4.5 Moment of resistance.
4.6 Derivation of flexural formula (Relation between bending stress, Radius of curvature and moment of resistance)
4.7 Shearing stress in beams.
4.8 Distribution of shear stress in rectangular cross section of beam.
4.9 Determination of bending stress for simple beams
4.10 Section modulus.

Unit 5: Deflection of Beams **[6 Hrs]**

5.1 Definition of elastic curve, slope and deflection of beam.
5.2 Differential equation of elastic curve.
5.3 Deflection of simply supported and cantilever beams.

Unit 6: Torsion: **[6 Hrs]**

6.1 Introduction.
6.2 Definition of torque and angle of twist.
6.3 Stress due to torsion.
6.4 Derivation of torsional equation.
6.5 Strength of solid and hollow circular shaft.
6.6 Power transmitted by shaft.

Unit 7: Simple Strut Theory: **[8 Hrs]**

7.1 Definition of column and strut.
7.2 Stability of columns
7.3 End conditions and their effects.
7.4 Derivation of Euler's formula for columns for different types of end conditions
7.5 Effective height and Slenderness ratio.
7.6 Introduction to eccentrically loaded column.

Tutorial: ***[30 Hrs]***

Unit 1: Introduction: **[2 Hrs]**

1.1 Differentiate statically determinate and indeterminate structures
1.2 Determine of degrees of static indeterminacies.

Unit 2: Simple Stress and Strain: **[8 Hrs]**

2.1 Calculate deformation of uniform bar due to axial load
2.2 Draw stress strain curves for different materials and find out ultimate strength, yield strength and working stress.
2.3 Calculate stress and strains in plain and composite bars due to external and thermal loading.
2.4 Calculate poisson's ratio, Shear stress, shear strain and modulus of rigidity.
2.5 Calculate volumetric strain and Bulk modulus.

Unit 3: Axial force, Shearing force and Bending moment: **[8 Hrs]**

3.1 Draw axial force, shear force and bending moment diagrams for Beam and Frame.
3.2 Determine location of point of contra flexure.

Unit 4: Theory of Simple Bending: **[4 Hrs]**

4.1 Evaluate radius of curvature, neutral, bending stress and draw stress diagram.
4.2 Calculate moment of resistance and section modulus.

Unit 5: Deflection of beams: **[2 Hrs]**

5.1 Determine deflection of simply supported and cantilever beams.

Unit 6: Torsion: **[2 Hrs]**

6.1 Determine stress in solid and hollow circular shaft.
6.2 Determine strength of solid and hollow circular shaft.
6.3 Evaluate power transmitted by shaft.

Unit 7: Simple Strut Theory: **[4 Hrs]**

7.1 Determine critical load for different types of columns and strut.

Practical/Laboratory ***[15 Hrs]***

1 Determine Young's modulus, yield stress and ultimate strength of mild steel specimen (Stress-strain curve)
2 Measure strain and determine force in members of a plane truss
3 Measure deflection of simple beams
4 Determine buckling load of different types of columns

References:

1. G. B. Motra, “A text book of strength of materials”, Heritage Publishers & Distributors Pvt. Ltd, Kathmandu, Nepal.
2. R.K. Rajput "Strength of Materials", S. Chand & Co. Ltd., India.
3. Surendra Singh, “Strength of materials”, S. K. Kataria and Sons.
4. Ferdinand P. Beer, E Russell Johnston “Mechanics of Materials”, McGraw Hill Book.

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	Introduction	4	5
2	Simple Stress and Strain	14	19
3	Axial Force, Shearing force and Bending Moment	12	16
4	Theory of Simple Bending	10	13
5	Deflection of Beams	6	8
6	Torsion	6	8
7	Simple Strut Theory	8	11
	Total	**60**	**80**

**** There may be minor deviation in marks distribution.***

Workshop Practice II

EG 2105 HE

Year: II **Total: 7 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: 4 Hrs/week
Lab: Hrs/week

Course Description:

This course intends to impart basic knowledge and skills on bricklaying and plumbing works. It also covers the basics of welding process.

Course Objectives:

After the completion of this course students will be able to:

1. Introduce brick laying;
2. Perform different bricklaying works.
3. Identify and select the tools and equipment required for bricklaying
4. Perform bricklaying works on various bonding patterns.
5. Identify the tools and equipment required to plumbing works
6. Perform simple pipe fittings works
7. Prepare the PVC fittings.
8. Perform simple plumbing joining and installation works.
9. Explain the use and working of welding process
10. Perform basic welding operations.

Course Contents:

Part I: Bricklaying

Unit 1: Introduction and Safety Precaution in Bricklaying [2 Hrs]

1.1. Introduction
1.2. History of Bricklaying
1.3. Importance of Bricklaying
1.4. Scope of Bricklaying
1.5. Beauty of Bricklaying (Aesthetics of Bricklaying)
1.6. Use of protective clothing and equipment
1.7. Maintaining tools and equipment
1.8. Awareness of personal safety and safety of others in all aspects of works
1.9. Observation of workshops safety rules and regulations

Unit 2: Bricklaying Materials [2 Hrs]

2.1 Bricks in common use
2.2 Bricks in Chinese bricks/Dachi Bricks
2.3 Bricks in hand made bricks

2.4 Bricks in 5% cement added sun dried soil bricks
2.5 sand used in Bricklaying
2.6 Lime/Cement used in Bricklaying
2.7 Amount of water used in mixing Mortar/concrete
2.8 Admixture and their properties.

Unit 3: Bricklaying Tools and Machines: [2 Hrs]

3.1 Introduction
3.2 Types of bricklaying hand tools: trowel, pointing trowel, plum bob, sprit level, line and pin/corner block, Mason's line, Straight edge/storey rod, Gang rod, Club Hammer, Bolster and closer or bat gauge.
3.3 Shovel, spade, wheel barrow, buckets, jugs, sponge, Hesign Rags, Foam, Runner/Jointer, Mortar Boards, Mortar pan and Brooms for cleaning floor
3.4 Protective equipment e.g. Hand gloves, ear plugs and Mask etc.
3.5 Mortar mixer

Unit 4: Constructing Walls using Bricks in Lime Mortar English and Flemish Bond [4 Hrs]

4.1 English Bond
  4.1.1 Building ½ Brick (4.5" thick wall) to stretcher Bond
  4.1.2 Building 1 Brick (9" thick wall) to English Bond
4.2 Flemish Bond
  4.2.1 Flemish Bond-1 Brick thick, 1.5 Brick and 2 brick thick double Flemish bond wall.
  4.2.2 Making of one end stopped and other end racked back.
  4.2.3 Constructing cavity wall, 12" thick making cavity of 3" wide.
  4.2.4 Constructing rat trap bond 1 brick thick (9" thick wall)

Unit 5: Pointing and Curing Walls [3 Hrs]

5.1 Introduction
5.2 Mortar for pointing/Ratio and proportion
5.3 Pointing procedure
5.4 Pointing as the work proceeds
5.5 Pointing after the Brick work is completed
5.6 Types of pointing:
  (a) flush pointing
  (b) Struck joint or pointing
  (c) Weather struck and cut pointing
  (d) Rounded or tooled pointing
  (e) Recessed pointing
  (f) Tuck pointing
  (g) V-joint pointing
  (h) Purpose of pointing
  (i) Advantage of pointing.

5.7 Curing Walls

5.7.1 Curing wall both side by water pouring from top

5.7.2 Curing wall both side by sprinkling water at face

5.7.3 Temporary covering wall by heavy rain, frost and dirty materials nearby building operation

5.7.4 Liquid curing in hot climate

5.7.5 Cleaning wall by chemicals and acids

Unit 6: Building Foundation Footing Courses Wall (Square footing): [2 Hrs]

6.1 2.5 Bricks*2.5 Bricks square footing

6.2 3.5 Bricks*3.5 Bricks square footing

6.3 3.0 Bricks*3.0 Bricks square footing

6.4 Purpose and advantage of foundation footing

Part II: Plumbing

Unit 7: Introduction to Plumbing and Hand Tools [3 Hrs]

7.1 History of plumbing.

7.2 Importance of plumbing

7.3 Plumbing and sanitary

7.4 Scope of plumbing

7.5 Plumber's Hand tools

7.5.1 Pipe wrench of size 12”, 9”, and up to 18” long.

7.5.2 Pair of footprints.

7.5.3 Stocks and dies, up to 2” diameter, replacement of cutters

7.5.4 Wrench chain

7.5.5 Hack's saw frame and blade

7.5.6 Measuring tape

7.5.7 Soldering iron

7.5.8 Tin snips

7.5.9 Rasp

7.5.10 Caulking iron

7.5.11 Adjustable wrench up to 12 long.

7.5.12 Claw hammers /Ball pin hammer/Claw hammer

7.5.13 Pipe cutter-use and care adjustment of cutting wheels.

7.5.14 Drilling machine and its bits.

7.5.15 Pipe vice

7.5.16 Bench vice

7.5.17 Spanners of various size

7.5.18 Folding rules metallic/steel

7.5.19 Try square, Vernier caliper joining elements: - Nuts, bolts, washer, pins, screws and rivets and jute/pipe tape and lead.

Unit 8: Galvanized Pipe Fittings: **[2 Hrs]**

8.1 G.I pipe nipples
8.2 G.I. elbows
8.3 G.I tee
8.4 G.I cross
8.5 G.I reducing elbow
8.6 G.I reducing tee and reducing cross
8.7 G.I sockets
8.8 G.I reducing sockets
8.9 G.I lock nut
8.10 G.I plugs or caps
8.11 Flange unions (Gasket)
8.12 G.I gate valve (heavy and light)
8.13 Foot valve/Glove valve
8.14 Pipe tape
8.15 Float valve or ball valve.

Unit 9: Pipe Threading and Assembly to Fittings **[4 Hrs]**

9.1 Fixing pipe to pipe vice
9.2 Measuring pipe to millimeter
9.3 Measuring methods
9.4 Die holding/threading methods
9.5 Die checking/cleaning/oiling
9.6 Die tightening and loosing/fixing cutter
9.7 Checking accurate threading and its sharpness
9.8 Doing loosen the die fixing the pipe to die and repeat the threading twice for sharpness. (Repeat)
9.9 Assembling the Threaded Pipe to Fittings
- 9.9.1 Visualization of drawing in detail
- 9.9.2 Collecting the fittings
- 9.9.3 Collecting the threaded pipes in position
- 9.9.4 Fixing the fittings with pipe tape to pipe in position
- 9.9.5 Checking the tightness/testing pipe joints
- 9.9.6 Adjusting measurement
- 9.9.7 Marking, laying, using chalk line to wall/floor/ceiling
- 9.9.8 Accurate pipe cutting with margin of necessary threads to pipe
- 9.9.9 Fixing pipe to pipe vice
- 9.9.10 Positioning techniques.

Unit 10: H.D.P and PVC Fittings: **[6 Hrs]**

10.1 Definition of HDP and PVC pipe and fittings

10.2 Collecting hot plate with power
10.3 Collecting HDP pipe with necessary diameters
10.4 Using miter box cutting pipe to 900
10.5 Clean, trim and weld the two halves of pipe to form 900 elbow (L)
10.6 Making Tee
10.7 Making Wyes(Y)

Part III: Welding

Unit 11: Arc Welding [7 Hrs]

11.1 Classification of welding
11.2 Components and working of typical arc welding
11.3 Arc column Theory
11.4 Arc welding machines: types, uses and care
11.5 Arc welding machine and operators' accessories
11.6 Influencing factors in arc welding: Correct position, Face protection, Arc length, Amperage, Angle and travel speed of electrode
11.7 Weld movement: types and application
11.8 Welding joints: types and application
11.9 Defects on welding process, cause and their possible remedy
11.10 Safety precautions in arc welding

Unit 12: Gas Welding [8 Hrs]

12.1 Oxy-acetylene welding principle
12.2 Oxyacetylene welding equipment and accessories: cylinders, regulator, wrenches, hose set, welding torch, filler rod holder, gas lighter
12.3 Oxy-acetylene flame: types, properties and use
12.4 Welding joints: types and application
12.5 Distortion in welding: types and their control
12.6 Testing of welding joints: types and process
12.7 Oxygen gas cutting: working principle, major influencing factors
12.8 Safety precaution in oxy-acetylene welding

Practical/Laboratory: ***[60 Hrs]***

Part I: Bricklaying [20 Hrs]

1. Identify and handle tools/equipment/materials related to bricklaying.
2. Lay stretcher bond wall making 1.5 m long and 6 courses high true to horizontal and vertical line and level properly.
3. Build English bond wall 1 brick thick (9") up to 6 courses high and ending at 1.5 m length true to horizontal and vertical line and level properly.
4. Build Flemish bond wall 1 brick thick (9") up to 6 courses high and ending at 1.5 m length true to horizontal and vertical line and level properly

5. Build English bond wall 1 brick thick (9") up to 6 courses high and 1.5m length with return corner true to horizontal and vertical line and level properly.
6. Build Flemish bond wall 1 brick thick (9") up to 6 courses high and 1.5m length with return corner true to horizontal and vertical line and level properly.
7. Build a T-junction 1 brick thick main wall with 1.5 m length in English bond and partition wall with 1.5 m length in stretcher bond up to 6 courses high.
8. Build a T-junction 1 brick thick main wall with 1.5 m length in Flemish bond and partition wall with 1 m length in stretcher bond up to 6 courses high
9. Build a cross-junction 1 brick thick main wall with 1.5 m length in English bond and partition cross wall with 1 m length both side in stretcher bond up to 6 courses high.
10. Build a cross-junction 1 brick thick main wall with 1.5 m length in Flemish bond and partition cross wall with 1 m length both side in stretcher bond up to 6 courses high.

Part II: Plumbing **[20 Hrs]**

1. Identify/enumerate/use hand tools and equipment
2. Demonstrate various types of pipes with different sizes.
3. Cut, file cut end and make thread to prepare nipples of different sizes of G.I pipe needed for assembling
4. Assemble previously threaded pipes and fittings to make a loop by using various fittings as Elbow, Union and tee.
5. Make L, cross and T bends of HDP pipe
6. Join HDP fittings with HDP pipe.
7. Make L, cross and T bends of PVC pipe
8. Join PVC fittings with PVC pipe.
9. Install PPR pipe with fittings.
10. Perform external (wall) pipe layout and join fittings for water supply.

Part III: Welding **[20 Hrs]**

1. Safety precaution and familiarization with welding machine and accessories
2. Striking an arc welding on plate
3. Padding on flat surface
4. Closed and Square butt joint
5. Arc welding joints: Corner, Tee, Lap, V
6. Gas welding Lining with and without filler rod
7. Gas welding joint: Butt, Corner, Lap, Tee
8. Practice on linear/circular gas cutting

References:

1. B. C. Punmia, A.K. Jain, "Building Construction", Laxmi Publication Pvt. Ltd.
2. G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering".
3. S.G. Deolakar, "Plumbing Design and Practice", Tata McGraw-Hill Publishing Company Limited.
4. C. McConnell, "Plumbers and pipe fitter's library, volume I, II, and III", Macmillan publishing company.
5. J.D. Tailor, "Plumbing Practice vol 1", I.L.O.
6. Loknath Pudasaini, "Plumbing handbook", Bhudipuran Publication, Kathmandu, Nepal.
7. B. S. Raghuwanshi, "A Course in Workshop Technology, Vol. II", Dhanpat Rai and Co. (P) Ltd, Delhi, India.
8. S. K. Hajra Choudhury, S.K. Bose and A. K. Hajra Choudhury, "Elements of Workshop Technology Vol. I", Media Promoters and Publishers Pvt Ltd, Bombay, India.
9. R. S. Khurmi and J. K. Gupta, "A text book of Workshop Technology", S. Chand and Company Ltd, New Delhi, India.

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	Introduction and Safety Precaution in Bricklaying	2	4
2	Bricklaying Materials	2	4
3	Bricklaying Tools and Machines	2	4
4	Constructing Walls using Bricks in Lime Mortar English and Flemish Bond	4	8
5	Pointing and Curing Walls	3	6
6	Building Foundation Footing Courses Wall (Square footing)	2	4
7	Introduction to Plumbing and Hand Tools	3	6
8	Galvanized Pipe Fittings	2	4
9	Pipe Threading and Assembly to Fittings	4	8
10	H.D.P and PVC Fittings	6	8
11	Arc Welding	7	12
12	Gas Welding	8	12
	Total	**45**	**80**

Note: There might be minor deviation on above specified marks

Engineering Geology
EG 2106 HE

Year: II **Total: 3 Hrs/week**
Part: I **Lecture: 2 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course description:
This course deals with the basics of engineering geology. It covers six units namely introduction, physical geology, petrology, structural geology, geological investigation and geology of Nepal. It also some the laboratory work for the concerned topics.

Course Objectives:
At the end of this course the student will be able to
1. Apply geological knowledge this knowledge in various engineering projects.
2. Perform geological Investigation.
3. Measure attitude of Geological Strata
4. Identify rocks in the field.
5. Study rock Structures (In Block diagram and in the Field)
6. Identify Topographic Maps and Prepare Profile.

Course contents:

Unit 1: Introduction **[2 Hrs]**
- 1.1 Geology and Branches of geology
- 1.2 Engineering geology and its importance in civil engineering

Unit 2: Physical Geology **[6 Hrs]**
- 2.1 Structure of Earth and its Composition
- 2.2 Plate tectonics and mountain building processes and Formation of Himalayas.
- 2.3 Landform and processes associated with river and groundwater
- 2.3 Geological Hazard (Earthquake, Flood and Landslide)

Unit 3: Petrology **[6 Hrs]**
- 3.1 Petrology, Crystal, Minerals
- 3.2 Rock forming Minerals
- 3.3 Classification of rocks with structure
- 3.4 Differentiate between three rocks types (Igneous, Sedimentary and Metamorphic Rocks) and its engineering significance
- 3.5 Engineering properties of common rock types found in Nepal (Granite, Pegmatite, Shale, Sandstone, Limestone, Dolomite, Slate, Phyllite, Schist, Amphibolite Gneiss, Quartzite and Marble)

Unit 4: Structural Geology **[6 Hrs]**
- 4.1 Attitude of Geological Strata (Strike and Dip (Dip Amount and Dip Direction)
- 4.2 Geological Structures

- Primary Structures- Lamination, Bedding Plane, Graded Bedding, Ripple Marks and Mud Cracks
- Secondary Structures- Foliation, Folds, Faults and Joints

4.3 Clues for identification of fold and Fault in the field

4.4 Importance of Geological Structures in Civil Engineering

Unit 5: Geological Investigation [6 Hrs]

5.1 Types of Mass Movement and their classification (Landslide, Slope Failure and Debris Flow) Causes and Preventive Measures.

5.2 Modes of Rock Failure (Plane, Wedge and toppling failure)

5.3 Geological condition necessary for design and construction of Dams, Reservoirs, Tunnels, Bridge and road cuttings.

Unit 6: Geology of Nepal [4 Hrs]

6.1 Geological Division of Nepal

6.2 Major geological Structures and their engineering significance

Practical/Laboratory: ***[15 Hrs]***

1. Field excursion for identification of rock in the field and field observation of landslide.
2. Measurement of attitude of Geological Strata
3. Identification of rocks in the field.
4. Study of rock Structures (In Block diagram and in the Field)
5. Study of Topographic Maps and Preparation of Profile.
6. Plotting of stereo net diagram.
7. Preparing the sketch and determination of failure type of Landslide in field.

References:

1. Principles of Physical Geology: A. holmes, ELBS English Language Society
2. Principles of Structural Geology: M.P Billings, Prentice Hall of India, New Delhi
3. Geology of Nepal: Dr. C. K. Sharma, Educational Enterprises
4. Geology for Engineers: Blyth, F. G. H., Freitas, M. H., ELBS

Marks Specification for final Examination:

Unit	Content	Course Hours	Marks
1	Introduction	2	2
2	Physical Geology	6	10
3	Petrology	6	10
4	Structural Geology	6	10
5	Geological Investigation	6	10
6	Geology of Nepal	4	8
Total		**30**	**50**

Note: There may be minor variation in marks distribution

Fourth Semester
Year II Part I

Subjects:

1	EG 2201 HE	Basic Electrical Engineering
2	EG 2202 HE	Building Construction
3	EG 2203 HE	Surveying II
4	EG 2204 HE	Estimating and Costing I
5	EG 2205 HE	Soil Mechanics and Foundation Engineering
6	EG 2206 HE	Hydrology and Irrigation

Basic Electrical Engineering

EG 2201 HE

Year: II **Total: 6 Hrs/week**

Part: II **Lecture: 3 Hrs/week**

Tutorial: Hrs/week

Practical: Hrs/week

Lab: 3 Hrs/week

Course Description:

The course deals with basic concept of electricity, DC system, 1-phase and 3-phase AC system, electrical protection systems, basic electronics and fundamentals of AC machines.

Course Objectives:

1. Known the basic concept parameters of electricity.
2. Familiarize with electrical quantities.
3. Understand the basic circuit theory.
4. Gain the knowledge of measuring instrument used in hydropower station.
5. Understand the basic concept of protection system.
6. Understand the basic concept of electronic devices.
7. Understand the basic concept of Electrical Machines.

Course Contents:

Unit 1: Introduction **[3 Hrs]**

1.1.Conductor, Insulator, semiconductor
1.2.Voltage, current and resistance
1.3. AC and DC system, electrical power and energy, torque,
1.4. Fundamentals of Battery and Cell (Lead acid battery, Li-ion battery)

Unit 2: Electrical Circuit Fundamental **[5 Hrs]**

2.1 Circuits: Resistor, Inductor and Capacitor in Series, Parallel and Mix circuits
2.2 Ohm's law, its application and limitations
2.3 Kirchhoff's Law and their application
2.4 Maximum power transfer theorem and its applications in electrical circuits

Unit 3: AC Circuit Analysis **[8 Hrs]**

3.1 Generation of 1-phase AC voltage and current
3.2 Waveform and terms used in AC: Cycle, frequency, time period, amplitude, phase and phase difference
3.3 Peak, average and r.m.s value of alternating current or voltage
3.4 AC in resistive, inductive and capacitive circuits (equation and waveform of: current, voltage and power)
3.5 AC in RLC series circuit (equation and waveform of current and voltage; analysis of power and power factor)
3.6 Types of power in AC, power factor, its practical importance and power factor improvement
3.7 Measurement of power in single phase AC circuit

Unit 4: Three-Phase Circuit Analysis **[6 Hrs]**

4.1 Basic concept and advantages of 3-phase system
4.2 Phase and line quantities in Star and Delta connections
4.3 Balance and unbalance 3-phase system
4.4 Power calculation in 3-phase system

Unit 5: Measuring Instrument **[5 Hrs]**

5.1 Basic operation and circuit of Ammeter and Voltmeter
5.2 Frequency meter: basic concept and operation
5.3 Multimeter operation
5.4 Energy meter (1-phase, and 3-phase)
5.5 Power factor meter: connection and general concept
5.6 Basic concept of Current Transformer (CT) and Potential Transformer (PT) for measurements

Unit 6: Protection System **[7 Hrs]**

6.1 Basic knowledge and application of Fuse, MCB, MCCB, RCD with their connection in circuit
6.2 Uses of circuit breaker in Hydro Power
- Basic concept and application of OCB, MOCB
- Basic Concept and application of ACB, SF6 circuit breaker

6.3 Earthing (equipment, system earthing) and its importance, materials used in earthing

Unit 7: Electronic Devices **[6 Hrs]**

7.1 Basic Concept of Diode: Introduction to PN junction diode, Basic structure, forward and reverse biasing, working principle and VI characteristics
7.2 Application of diode: Rectifier and types of rectifier (half wave and full wave bridge rectifier)
7.3 Transistor: Physical structure and modes of operation, Types of BJT, Transistor configuration (CE, CB, CC) and its applications
7.4 Introduction to FET, Classification of FET (JFET and MOSFET), MOSFET: working and applications
7.5 Introduction to Silicon Controlled Rectifier (SCR) and its applications

Unit 8: Electromechanical Machines **[5 Hrs]**

8.1 Faraday's law of electromagnetic induction
8.2 Operating principle and components of Generator (1-phase and 3-phase)
8.3 Operating principle and components of motor (1-phase and 3-phase)
8.4 Listing the electromechanical machines use in Hydro power plants.

Practical/Laboratory: ***[3*15=45 Hrs]***

1. Use of ammeter, voltmeter and multimeter to measure current and voltage [3 hrs]
2. Verification of ohm's law. [3 hrs]
3. Verification of KCL and KVL. [6 hrs]
4. Measurement of AC circuit parameters using RLC series circuit with oscilloscope. [6 hrs]
5. Voltage, current and power measurements in 1-Ǿ and 3-Ǿ system [6 hrs]
6. Measurement of power factor of 1-phase and 3-phase ac loads [6]
7. Handling and connection idea of Energy meter, Power factor meter, frequency meter, ammeter and voltmeter [3 hrs]
8. Measurement of earth resistance using megger and demonstration of earthing system [6 hrs]
9. Demonstration of 3-phase motor connection (Star/Delta) with motor control circuit [6 hrs]

References:

1. B. L. Thareja & A.K. Thareja, "A text book of electrical technology (Volume I and II)", S. Chand and Company, India
2. S. K. Sahdev, "Fundamentals of Electrical Engineering & Electronics", Dhanapati Rai & Company, India
3. J.B. Gupta, "Fundamentals of Electrical Engineering and Electronics", S.K. Kataria & Sons.
4. Theodore F Bogart, Jeffrey S. Beasley and Guillermo Rico, "Electronics Devices and Circuits", Pearson Education India
5. J.B. Gupta, "An Integrated Course in Electronics Engineering", S.K Kataria & Sons
6. V. K. Metha, "Fundamental Electrical Engineering", S. Chand and Company, India

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Introduction	3	4
2	Electrical Circuit Fundamental	5	10
3	AC Circuit Analysis	8	16
4	Three-Phase Circuit Analysis	6	10
5	Measuring Instrument	5	8
6	Protection System	7	12
7	Electronic Devices	6	10
8	Electromechanical Machines	5	10
Total		**45**	**80**

Note: There might be minor deviation on the above specified marks

Building Construction

EG 2202 HE

Year: II **Total: 8 Hrs/week**

Part: II **Lecture: 5 Hrs/week**

Tutorial: 1 Hrs/week

Practical: Hrs/week

Lab: 2 Hrs/week

Course description:

This 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.

Course objectives:

After the completion of this course students will be able to:

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 and
4. Acquire knowledge and skills on earthquake resistant building construction techniques.

Course Contents:

Unit 1: Introduction to Building Construction: **[2 Hrs]**

1.1 Definition of building and its uses
1.2 Building types
1.3 General components of a building
1.4 Technical terms used in buildings
1.5 General requirements of parts of building
1.6 General rules of Vaastu

Unit 2: Foundation and Its Types: **[7 Hrs]**

2.1 Foundation and its purposes
2.2 Site exploration and its purposes
2.3 Preliminary soil investigation
2.4 Methods of site investigation
2.5 Depth and spacing of trial pits or bore holes
2.6 Setting out of foundation
2.7 Causes of failure of foundation and remedy
2.8 Timbering of trenches
2.9 Types of Foundation: Shallow and Deep foundation
2.10 Construction of foundation under water lodged trenches.
2.11 Design example on masonry wall foundation
2.12 Design example on brick pillar foundation

Unit 3: Brick Masonry: **[8 Hrs]**

3.1 General introduction to
- 3.1.1 Types of bricks
- 3.1.2 Types of bonds
- 3.1.3 Types of junctions

3.2 Load bearing and non-load bearing wall
3.3 Bonds in Piers
3.4 Piers attached to main walls
3.5 Retaining wall
3.6 Stability of retaining walls
3.7 Thumb rules of retaining wall construction
3.8 Strength of brick masonry
3.9 Permissible compressive stress in brick masonry
3.10 Defects in brick masonry
3.11 Reinforced brickwork
3.12 Partition and Cavity wall:
- 3.12.1 Objectives of partition wall
- 3.12.2 Types of partition walls
- 3.12.3 Advantage of cavity wall
- 3.12.4 Position of cavity
- 3.12.5 Wall ties and construction details
- 3.12.6 Precautions on cavity construction
- 3.12.7 Curtain Wall

Unit 4: Stone Masonry: **[6 Hrs]**

4.1. General definition
4.2. Technical Terms used in masonry
4.3. Dressing and selection of surface finish
4.4. Setting of stonework
4.5. General principles to be observed in stone masonry construction
4.6. Types of Stone masonry (Rubble and Ashlar)
4.7. Selection of stone for masonry
4.8. Stone masonry block construction
4.9. Safe permissible loads on stone masonry.
4.10. Composite masonry in stone and brick
4.11. Cement concrete block masonry

Unit 5: Damp and Water Proofing: **[3 Hrs]**

5.1 Dampness and its effects on construction works
5.2 Causes and sources of dampness
5.3 Methods of damp proofing
5.4 Materials used for damp proofing
5.5 Damp proofing treatment in
- 5.5.1 Foundation/Basement
- 5.5.2 Walls
- 5.5.3 Floors
- 5.5.4 Roofs
- 5.5.5 Parapet walls

Unit 6: Concrete and Its Construction: **[10 Hrs]**

- 6.1 Concrete and grades of concrete
- 6.2 Properties of concrete
- 6.3 Methods of proportioning concrete mixes
- 6.4 Mix design
  - 6.4.1 Design mix
  - 6.4.2 Nominal mix
- 6.5 Concreting processes
  - 6.5.1 Batching of materials
  - 6.5.2 Concrete mixing
  - 6.5.3 Transportation of concrete
  - 6.5.4 Placing of concrete
  - 6.5.5 Compaction of concrete
  - 6.5.6 Curing of concrete
- 6.6 Admixture
- 6.7 Concreting under water
- 6.8 Placing under cold weather
- 6.9 Placing concrete in hot weather
- 6.10 Shrinkage, Bleeding, Segregation, Harshness and Creep of Concrete
- 6.11 Steel reinforcement
- 6.12 Permissible stresses in reinforcement
- 6.13 Reinforced cement concrete and its characteristics
- 6.14 Advantages of reinforced cement concrete
- 6.15 Concreting equipment and accessories
- 6.16 Causes of failure of reinforced concrete structure

Unit 7: Temporary Construction: **[4 Hrs]**

- 7.1 Characteristics of good formwork
- 7.2 Materials for formwork
  - 7.2.1 Timber formwork
  - 7.2.2 Plywood formwork
  - 7.2.3 Steel formwork
- 7.3 Construction of formwork
- 7.4 Order and method of removing formwork
- 7.5 Types of shoring and their uses
- 7.6 Types of scaffolding and their uses.
- 7.7 Underpinning

Unit 8: Lintels and Arches: **[2 Hrs]**

- 8.1 Lintels and its uses
- 8.2 Types of lintels in terms of material used
- 8.3 Arch and its uses
- 8.4 Types of arches and materials of construction

Unit 9: Floors and Floor Finishes: **[6 Hrs]**

- 9.1 Ground floor and its types
  - 9.1.1 Mud floor

9.1.2 Brick floor
9.1.3 Timber floor
9.1.4 Flagstone floor
9.1.5 Tile floor
9.1.6 Marble floor
9.1.7 Concrete floor

9.2 Upper floor and its types
9.2.1 Timber floor
9.2.2 Reinforced cement concrete floor
9.2.3 Reinforced brickwork floor
9.2.4 Precast concrete floor

9.3 Floor finishes and construction methods
9.3.1 Screed/Plaster punning
9.3.2 Mosaic tile
9.3.3 Porcelain ceramic tile
9.3.4 Marble, Granite
9.3.5 Parqueting

Unit 10: Stairs and Roofs: **[6 Hrs]**

10.1 Means of Vertical communication: Stair, Lift, Ladder and Escalator
10.2 Location of stair, types of stairs
10.3 Technical terms used
10.4 Requirements of good stair
10.5 Fixing of going and rise
10.6 Introduction and types of roofs
10.6.1 Slope or pitched roof
10.6.1.1 Lean to roof
10.6.1.2 Coupled roof
10.6.1.3 Scissors roof
10.6.1.4 King and Queen post roof truss
10.6.2 Flat roof
10.6.2.1 Mud terraced roof
10.6.2.3 Brick, glazed tiled roof

10.7 Roof covering
10.7.1 Thatch covering
10.7.2 Shingle
10.7.3 Tile
10.7.4 A.C. and C.G.I. sheet
10.7.5 Slate
10.7.6 Laying and fixing of roof coverings

Unit 11: Doors and Windows: **[6 Hrs]**

11.1 Location of doors and door sizes
11.2 Door frame
11.3 Types of doors
11.3.1 Battened, ledged braced and framed door
11.3.2 Framed and Paneled door

11.3.3 Flush door
11.3.4 Sliding door
11.3.5 Revolving door
11.3.6 Collapsible steel door
11.3.7 Rolling steel shutter door

11.4 Types of windows
11.4.1 Fixed window
11.4.2 Sliding window
11.4.3 Double hung window
11.4.4 Casement window
11.4.5 Sash or glazed window
11.4.6 Corner window
11.4.7 Bay window
11.4.8 Ventilators
11.5 Erecting and fixing of door and window frames
11.6 Fixtures and fastenings of door and windows

Unit 12: Finishing Works: **[3 Hrs]**

12.1 Plaster works
12.1.1 Material used (mud, lime, cement, surkhi)
12.1.2 Process of plastering
12.1.3 Pointing works on brick and stone masonry
12.2 Paints and Painting procedure
12.2.1 Cement paint
12.2.2 Enamel paint
12.2.3 Distemper
12.2.4 Emulsion paint
12.2.5 Varnishes and its uses
12.3 Heritage plaster

Unit 13: Miscellaneous Construction Works: **[2 Hrs]**

13.1 Purpose and materials used for false ceiling
13.2 Plaster of Paris works and wall putty.
13.3 Causes and prevention of cracks in buildings
13.4 Joints uses and types
13.5 Methods to prevent termite action

Unit 14: Earthquake Protection: **[10 Hrs]**

14.1 Concept of earthquake [2 Hrs]
14.1.1 Introduction
14.1.2 Terminologies
14.1.3 Causes of earthquake
14.1.4 Earthquake locations
14.1.5 Measurement of Earthquake
14.1.5.1 Earthquake Magnitude
14.1.5.2 Earthquake Intensity

14.1.6 Seismicity of Nepal
14.1.7 Seismic hazard of Nepal
14.1.8 Effects of Earthquake on buildings

14.2 Lateral load resisting system [2 Hrs]
14.2.1. Building configuration
14.2.2. Height and number of storey
14.2.3 Distribution of load bearing elements
14.2.4. Location and size of door and window openings
14.2.5 In plane and out of plane failure

14.3 Masonry building with rectangular building units in cement mortar [2 Hrs]
14.3.1. Construction Techniques of Improving for seismic safety
14.3.2. Foundation
14.3.2.1.RC Strip
14.3.2.2 PCC Strip / lime Strip
14.3.2.3. Plum concrete
14.3.2.4. Brick / stone masonry
14.3.3. Walls
14.3.3.1. Openings
14.3.3.2. Reinforcement of opening
14.3.3.3. Wall Reinforcement
14.3.3.3.1. Strengthening the junctions
14.3.3.3.2. Bands
14.3.3.3.3. Vertical Reinforcement

14.4. Concrete block walls
14.5. Separation and crumple sections

14.6 Low strength Masonry in rectangular block and stone [2 Hrs]
14.6.1. Definition
14.6.2. Limitations
14.6.3. Strengthening measures
14.6.4. Materials
14.6.5. Walls
14.6.5.1. Thickness
14.6.5.2. Buttresses
14.6.5.3. Door and window openings
14.6.5.3.1. Rectangular block masonry
14.6.5.3.2. Stone masonry
14.6.5.4. Construction
14.6.5.4.1. Block masonry
14.6.5.4.2. Stone masonry
14.6.5.5. Stitches
14.6.5.6. Bands
14.6.5.7. Vertical Reinforcing
14.6.6. Retrofitting techniques and retrofitting materials

14.7 Detailing of RC Frames [2 Hrs]
14.7.1. Foundation
14.7.2. Beam
14.7.2.1. Dimensions

14.7.2.2. Longitudinal Reinforcement
14.7.2.3. Web Reinforcement
14.7.3. Column
14.7.3.1. Dimension
14.7.3.2. Longitudinal Reinforcement
14.7.3.3. Web Reinforcement
14.7.4. Beam Column Joint
14.7.4.1. Transverse Reinforcements

Tutorials: ***[15 Hrs]***

1. **Unit 2: Foundation and its types**
   Design example on masonry wall foundation. [2 hrs]
   Design example on brick pillar foundation. [2 hrs]
2. **Unit 3: Brick Masonry**
   Stability of retaining walls. [2 hrs]
3. **Unit 6: Concrete and its Construction**
   Mix design [5 hrs]
4. **Unit 10: Stairs and Roofs**
   Fixing of going and rise [2 hrs]
5. **Unit 14: Earthquake**
   Defining wall and reinforcement of opening. [2 hrs]

Practical/Laboratory: ***[30 Hrs]***

Unit 1: Laboratory: **[15 Hrs]**

1. Test bulking of sand
2. Perform slump test
3. Perform compressive strength test of local and machine made bricks
4. Perform compressive strength of concrete/Hollow blocks
5. Observe effects of water cement ratio on concrete

Unit 2: Designs and Drawings Study and Field visit: **[15 Hrs]**

Interpret designs/drawings and administer hand on practice on Earthquake resistant construction of following buildings:

1. Stone masonry houses
2. Timber houses
3. Brick and block masonry houses
4. Reinforced Concrete buildings
5. Repair and strengthening existing buildings

References:

1. B.C. Punmia, "Building Construction".
2. Sushil Kumar, "Building Construction".
3. S. K. Sharma & B. K. Kaul, "Building Construction".
4. Gurucharan Singh, "Building Planning & Design".
5. A. S. Arya, "Masonry and Timber Structure including Earth".
6. Jain, "Plain Cement Concrete, Vol. I & II".
7. Sushil Kumar, "Reinforced Concrete Structure"
8. B.C. Punmia, "Reinforced Concrete Structure, Vol. I & II"
9. IS 4326-1993; Earthquake Resistant Design and Construction of Buildings-Code of Practice, Bureau of Indian Standards, New Delhi, India
10. Department of Urban Development, *Nepal Building Code*
11. NBC 108-1994; Site Consideration, Government of Nepal, Ministry of Housing and Physical Planning, Department of Buildings, Nepal, 1995.
12. NBC 109-1994; Masonry: Unreinforced, Government of Nepal, Ministry of Housing and Physical Planning, Department of Buildings, Nepal, 1995.
13. NBC 201-1994; Mandatory Rules of Thumb: Reinforced Concrete Buildings with Masonry Infill, Government of Nepal, Ministry of Housing and Physical Planning, Department of Buildings, Nepal, 1995.
14. NBC 202-1994; Mandatory Rules of Thumb Reinforced Concrete Buildings without Masonry Infill, Government of Nepal, Ministry of Housing and Physical Planning, Department of Buildings, Nepal, 1995.
15. NBC 202-1994; Mandatory Rules of Thumb: Load Bearing Masonry, Government of Nepal, Ministry of Housing and Physical Planning, Department of Buildings, Nepal, 1995.
16. NSET-Nepal: Earthquakes, A manual for designers and builders,

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Building Construction	2	2
2	Foundation and Its Types	7	7
3	Brick Masonry	8	9
4	Stone Masonry	6	7
5	Damp and Water Proofing	3	3
6	Concrete and Its Construction	10	10
7	Temporary Construction	4	4
8	Lintels and Arches	2	2
9	Floors and Floor Finishes	6	7
10	Stairs and Roofs	6	7
11	Doors and Windows	6	7
12	Finishing Works	3	3
13	Miscellaneous Construction Works	2	2
14	Earthquake Protection	10	10
Total		**75**	**80**

Note: There might be minor deviation in marks distribution.

Surveying II
EG 2203 HE

Year: II **Total: 7 Hrs/week**
Part: II **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: 4 Hrs/week
Lab: Hrs/week

Course description:

This course focuses on familiarization of different surveying techniques and equipment. The different surveying techniques include area, volume, coordinate system, and graphical and analytical method of mapping.

Course objectives:

After the completion of this course, students will be able to:
1. Familiarize with different surveying techniques of civil engineering field;
2. Apply modern survey techniques and
3. Use modern survey instruments for surveying, constructions and map making procedures.

Course Contents:

Unit 1: Theodolite: **[4 Hrs]**
- 1.1 Introduction and uses of theodolites
- 1.2 Components and geometry of Theodolite
- 1.3 Technical terms, fundamental lines and planes of theodolites
- 1.4 Working principle of theodolites
- 1.5 Temporary adjustment of theodolites
- 1.6 Measurement of angles: Horizontal, Zenithal, Vertical
- 1.7 Field book and errors in theodolites survey

Unit 2: Theodolite Traversing: **[7 Hrs]**
- 2.1 Traverse: definition, purpose, types and uses
- 2.2 Traverse: field works and principle
- 2.3 Traverse adjustment and computation of total coordinates
- 2.4 Traverse plotting
- 2.5 Omitted measurements in traverse

Unit 3: Area and Volume Measurements: **[7 Hrs]**
- 3.1 Basic definition
- 3.2 Area calculation of regular Boundary: dividing in to simple geometry, give and take method, area enclosed by traverse: DMD method, Using independent coordinate
- 3.3 Area Calculation of irregular boundary
  - 3.3.1 Mid ordinate method
  - 3.3.2 End ordinate method

3.3.2 Trapezoidal rule
3.3.3 Simpson's 1/3 rule
3.4 Area of cross section: Cut and fill
3.5 Volume calculation using cross section area: Trapezoidal and prismoidal formula

Unit 4: Trigonometric Leveling: **[4 Hrs]**

4.1 Introduction
4.2 Different cases of trigonometric leveling
4.3 Refraction and curvature correction by linear method
4.4 Field procedures and problems

Unit 5: Stadia Tacheometry: **[5 Hrs]**

5.1 Introduction
5.2 Instrument used for tacheometry
5.3 Different system of tacheometric measurements
5.3.1 Stadia method
5.3.2 Movable hair method
5.3.3 Tangential method
5.6 Sub tense bar method: Measurement of HZ distance and elevation
5.7 Field procedure of tacheometric surveying
5.8 Errors and their adjustment in tacheometric survey

Unit 6: Engineering Curves: **[9 Hrs]**

6.1 General definition and purposes
6.2 Classification of engineering curves
6.2.1 Horizontal curve (simple circular, compound, reverse, transition, combined and broken back)
6.2.2 Vertical curve (summit and sag)
6.3 Designation of curves
6.4 Elements of simple circular curve
6.5 Design and setting out of simple circular curves by ordinate from long chord, offsets ordinate from long chord, offsets from tangent and deflection angle method, two theodolite Method
6.6 Purpose of horizontal and vertical curves
6.7 Length of vertical curves
6.8 Computation and setting out of vertical curves by tangent correction and parabolic equation method
6.9 Introduction and purpose of transition curves

Unit 7: Total Station **[4 Hrs]**

7.1 Introduction
7.2 Features of Total Station
7.3 Electronic Data Recording
7.4 Summary of total station characteristics
7.5 Field procedure for total station in topographical survey

Unit 8: Geographic Positioning System (GPS) **[3 Hrs]**

8.1 Introduction, Definition of terms
8.2 Geographical Coordinate system
8.3 Component of GPS
8.4 Working Principles and uses of GPS
8.5 GPS positioning technique – static point positioning
8.6 GPS data processing

Unit 9: Geographic Information System (GIS) **[2 Hrs]**

9.1 Introduction
9.2 Application of GIS to Civil engineering projects

Practical (Field works): ***[60 Hrs]***

1. Care and instrument handling [5 Hrs]
2. Perform theodolite traverse, traverse computation and adjustment [15 Hrs]
4. Perform tacheometric surveying and prepare topographic map [15 Hrs]
5. Perform topographic survey using total station [10 Hrs]
6. Set out simple circular curve, transition curve and composite curves by linear and angular method [10 Hrs]
7. Perform GPS survey to prepare a thematic map of a given area. [5 Hrs]

Evaluation of Practical: Continuous evaluation (Viva + Instrumentation + Objective test

References:

1. B.C. Punmia, "Surveying"- Vol. I & II", Laxmi Publication New Delhi
2. R. Agor, " Surveying and Leveling", Khanna Publication New Delhi
3. SK Duggal, "Surveying" Vol. I & II", Tata McGraw Hill Publishing
4. N. Basnet & M. Basnet, "Basic Surveying I", Benchmark Education Support Pvt, Ltd, Tinkune Katmmandu
5. N. Basnet & M. Basnet, " Basic Surveying II", Rajmati Press, Lalitpur

Marks Specification for final examination:

Unit	Content	Course Hours	Marks
1	Theodolite	4	8
2	Theodolite Traversing	7	12
3	Area and Volume Measurements	7	12
4	Trigonometric Leveling	4	8
5	Stadia Tacheometry	5	8
6	Engineering Curves	9	16
7	Engineering Curves	4	8
8	Geographic Positioning System (GPS)	3	4
9	Geographic Information System (GIS)	2	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Estimating and Costing I

EG 2204 HE

Year: II **Total: 7 Hrs/week**

Part: II **Lecture: 3 Hrs/week**

Tutorial: Hrs/week

Practical: Hrs/week

Lab: 4 Hrs/week

Course description:

This course focuses on familiarization of estimating and costing of building works in four different sections with laboratory works.

Course Objective:

After completion of this course, Students are able to:

1. Prepare the estimated cost and actual cost.
2. Identify the procedures methods of measuring and quantifying the building works.
3. Prepare the estimating the cost of building works.

Course Contents:

Unit 1: Introduction: **[5 Hrs]**

- 1.1. Definition of estimate
- 1.2. Purpose of estimating
- 1.3. Estimate and the actual cost
- 1.4. Definition of terms
  - 1.4.1. Administrative approval
  - 1.4.2. Technical sanction
  - 1.4.3. Capital cost
  - 1.4.4. Schedule of rates
  - 1.4.5. Abstract of cost
  - 1.4.6. Bill of quantities
  - 1.4.7. Contingency
  - 1.4.8. Plinth area
  - 1.4.9. Carpet area
  - 1.4.10. Work charged establishment

Unit 2: Types of Estimates: **[8 Hrs]**

- 2.1 Approximate estimate
- 2.2 Detailed estimate
- 2.3 Revised estimate
- 2.4 Supplementary estimate
- 2.5 Annual repair and maintenance estimate
- 2.6 Extension and improvement estimate
- 2.7 Complete estimate of work/project
- 2.8 Split up of the cost of building work

Unit 3: Estimation of Building **[16 Hrs]**

3.1. Data required for preparation of detailed estimate
3.2. Principle of units of measurement
3.3. Units of measurement and payment for various items of work
3.4. Limits of measurement and degree of accuracy
3.5. Methods of taking out quantities of building work
3.6. Methods of measurement of building and other civil engineering works
3.7. Various types of forms used in estimating
3.8. Preparation of detailed estimate

Unit 4:Analysis of Rates: **[16 Hrs]**

4.1. Introduction
4.2. Purpose of analysis of rates
4.3. Requirements of rate
4.4. Factor affecting rate analysis
4.5. Importance of rate analysis
4.6. Terms used in analysis of rates
  4.6.1. Overhead cost
  4.6.2. Task or out turn work
  4.6.3. Labour rate
  4.6.4. Material rate
  4.6.5. Through rate
4.7. Government procedure of preparing analysis of rates for building works
4.8. Estimating quantities of materials

Practical/Laboratory: ***[60 Hrs]***

Taking out detailed quantities and preparing estimate for the following:

1. Estimate a wall
2. Estimate one room building with RCC flat roof
3. Estimate one room building (having verandah) with RCC flat roof
4. Estimate two roomed RCC framed structure building
5. Estimate steel reinforcement of footing, RCC beam, column and slab
6. Estimate stone and brick masonry retaining walls
7. Estimate steel tubular truss and purlins
8. Estimate dog legged staircase
9. Estimate septic tank and soak pit
10. Perform approximate estimation of building works, road works water supply and sanitary works, irrigation work and bridge works
11. Determine approximate quantities of materials and labour for building based on CBRI, Roorkee
12. Perform computerized estimation of quantities of building work

References:

1. Amarjit Aggarwal "Civil estimating quantity surveying and valuation", Katson Publishing House, Ludhiyana, India.
2. P.K. Guha, "Quantity Surveying-Principles and application", Khanna Publishers, India

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Introduction	5	8
2	Types of Estimates	8	16
3	Estimation of Building	16	28
4	Analysis of Rates	16	28
	Total	**45**	**80**

Note: There may be minor variation in marks distribution

Soil Mechanics and Foundation Engineering

EG 2205 HE

Year: II **Total: 7 Hrs/week**

Part: II **Lecture: 4 Hrs/week**

Tutorial: 2 Hrs/week

Practical: Hrs/week

Lab: 2/2 Hrs/week

Course description:

This course is intended to give student a brief introduction to the field of soil mechanics and use of the basic data for analyzing various soil problems common to the civil engineering.

Course objectives:

After the completion of this course, students will be able to:

1. Understand the fundamental and relevant principles of soil mechanics;
2. Have an overall picture of the behavior of soil;
3. Describe the nature of some of the soil problems encountered in civil engineering and
4. Formulate the basic technique and to develop the methodologies to solve the soil problem.

Course Contents:

Unit 1: Introduction: **[2 Hrs]**

- 1.1 Definition of soil and Soil mechanics
- 1.2 Scope of soil mechanics
- 1.3 Formation of soil, general classification depending on transporting agent and deposit media

Unit 2: Three Phase of Soil **[6 Hrs]**

- 2.1 Introduction
- 2.2 Phase diagrams
- 2.3 Basic elements of three phase: void ratio, porosity, air content, percentage of air void, degree of saturation, moisture content, specific gravity of solid
- 2.4 Volumetric relation: volume – mass, volume – weight relation
- 2.5 Determination of field density: core cutter method, sand replacement method, water displacement method
- 2.6 Determination of specific gravity and Moisture content

Unit 3: Index Properties of Soil **[4 Hrs]**

- 3.1 Introduction
- 3.2 Relative density
- 3.3 Particle size distribution: sieve analysis and sedimentation analysis
- 3.5 Consistency of soils
- 3.6 Determination of liquid limit and plastic limit
- 3.7 Various index related to consistency: plasticity index, liquidity index, consistency index, tough ness index

Unit 4: Soil Classification: **[6 Hrs]**

4.1 Purpose of soil classification
4.2 M.I.T classification system
4.2 Textural soil classification of soil
4.3 Unified soil classification of soil
4.4 Field identification of soil

Unit 5: Soil Water and Effective Stress **[9 Hrs]**

5.1 Types of water in soil mass
5.2 Permeability and factors affecting on permeability
5.3 Darcy's Law
5.4 Determination of coefficient of permeability: laboratory methods
5.5 Seepage through soils: flow net, calculation of discharge, uplift pressure on concrete dam, seepage through earthen dam, piping, graded filter
5.6 Principle of effective stress
5.7 Factors affection on effective stress
5.8 Quick sand condition
5.9 Approximate stress distribution method for loaded areas

Unit 6: Compaction: **[4 Hrs]**

6.1 Introduction
6.2 lab test: Standard proctor test , AASTHO test
6.3 Field compaction methods and their suitability
6.4 Factors affecting compaction
6.5 Compaction control in field

Unit 7: Consolidation: **[6 Hrs]**

7.1 Introduction
7.2 Primary and secondary consolidation
7.3 Settlement
7.4 Terzaghi's spring analogy to describe consolidation
7.5 Lab test: one-dimensional consolidation test
7.6 Pressure-void ratio curves
7.7 Co-efficient of compressibility
7.8 Co-efficient of volume change
7.9 Coefficient of compression
7.9 Computation of consolidation settlement

Unit 8: Shear Strength of Soils: **[6 Hrs]**

8.1 Introduction
8.2 Principle plane and principle stress
8.3 Mohr's circle for two dimensional stress system
8.4 Mohr-Coulomb failure theory
8.5 Determination of shear strength parameter
8.6 Direct shear test
8.7 Unconfined compression test

Unit 9: Earth Pressure Theory: **[5 Hrs]**

9.1 Introduction
9.2 Different types of lateral earth pressures
9.3 Rankine's earth pressure theory
9.4 Types of retaining walls: design and stability check
9.5 Principles of the design of retaining walls

Unit 10: Bearing Capacity: **[12 Hrs]**

10.1 Introduction
10.2 Types of foundation and their suitability
10.3 Requirements and Criteria for ideal Foundation
10.4 Types or principle mode of shear failure
10.4 Terms of Bearing Capacity
10.5 Terzaghi's bearing capacity theory
10.6 Bearing capacity of footing with finite dimensions
10.7 Effect of water table on bearing capacity
10.8 Pile: introduction, type, uses, Load carrying capacity from static formula, negative skin friction

Tutorials: ***[30 Hrs]***

Unit 1: Basic terms and Interrelationship [6 Hrs]
Unit 2: Particle size distribution and consistency Index [2 Hrs]
Unit 3: Determination of Coefficient of permeability and effective stress [6 Hrs]
Unit 4: Calculation of Dry density, moisture content, plotting of compaction curve [3 Hrs]
Unit 5: Coefficient of compressibility and volume change [3 Hrs]
Unit 6: Mohr column failure theory [3 Hrs]
Unit 7: Determination of Active earth and passive earth pressure by Rankine's earth pressure theory [4 Hrs]
Unit 8: Determination of Bearing capacity based on Terzaghis' bearing capacity theory [3 Hrs]

Practical/Laboratory: ***[15 Hrs]***

1. Perform sieve analysis of Coarse grained soil (1 session)
2. Determine specific gravity by Pycnometer method (1 session)
3. Determine liquid limit and plastic limit (1 session)
4. Determine field density by Sand replacement method and Core cutter method (1 session)
5. Perform compaction test: Standard proctor test (1 session)
6. Perform direct shear test (1 session)
7. Perform unconfined compression test (1 session)

References:

1. K.R Arora,"Soil Mechanics and Foundation Engineering" , Standard Publishers Distributors, Nai-sarak, New Delhi, India.
2. V.N.S Murthy "A Text Book of Soil Mechanics and Foundation Engineering in SI Units", UBS Distributors Ltd.
3. T.N Ramamurthy and T.G Sitaram, "Geotechnical Engineering, Soil Mechanics", S.Chand Publishing, New Delhi, India.
4. Sehgal "A text book of soil mechanics", S.B. CBS Publishers and Distributors, New Delhi, India.

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Introduction	2	4
2	Three Phase of Soil	12	10
3	Index Properties of Soil	6	6
4	Soil Classification	6	6
5	Soil Water and Effective Stress	15	12
6	Compaction	7	6
7	Consolidation	9	8
8	Shear Strength of Soils	9	8
9	Earth Pressure Theory	9	8
10	Bearing Capacity	15	12
	Total	**90**	**80**

Note: There might be minor deviation in marks distribution.

Hydrology and Irrigation

EG 2206 HE

Year: II **Total: 5 Hrs/week**
Part: II **Lecture: 3 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course Description:

This course focuses on teaching students the concept of hydrology and irrigation, and successfully applying technical knowledge of the subject for the design and management of water resources projects. It gives a practical approach to the various facts of the subject to solve engineering problems and to understand irrigation system

Course Objectives:

After completion of this course students will be able to:

1. Measure and estimate hydrological components: evaporation, infiltration, streamflow, etc.;
2. Integrate the physical hydrological processes and apply them to engineering practices.
3. Apply various statistical methods for hydrological analysis
4. Understand and analyses the channel flow and flood routing;
5. Estimate irrigation water requirements;
6. Identify suitable irrigation methods based on topography, crop, and water sources;
7. Design canals based on soil type;
8. Develop analytical skills relevant to the areas particularly the design of irrigation and drainage projects; and
9. Explain the function, operation, and maintenance of irrigation structures.

Course Contents:

Unit 1: Introduction to Hydrology **[2 Hrs]**

1.1. Definition of Engineering hydrology
1.2. Scope and Application of Hydrology in Civil Engineering
1.3. Hydrologic cycle and water balance equation

Unit 2: Precipitation **[5 Hrs]**

2.1 Causes, forms, and types of Precipitation
2.2 Types of Rain-gauge and Measurement of Rainfall
2.3 Estimation of Missing Rainfall Data
2.4 Presentation of Rainfall Data (Mass Curve, Hyetograph, Average Curve of Annual Rainfall)
2.5 Estimation of Mean Rainfall over an Area

Unit 3: Surface Runoff **[8 Hrs]**

3.1 Drainage Basin/Catchment Area
3.2 Hydrological Losses
3.3 Factors affecting Runoff from a Catchment

3.4 Rainfall-Runoff Relationship
3.5 Stream Gauging (Selection of Sites, types of Gauges, and Measurement)
3.6 Streamflow Measurement Methods
3.7 Development of Rating Curve and its Uses
3.8 Estimation of Monthly flows by Empirical Methods (MIP, HYDEST, CAR)
3.9 Hydrograph and Unit Hydrograph
3.10 Concept of Hydrograph analysis

Unit 4: Flood Hydrology **[2 Hrs]**

4.1 Design flood and its frequency, introduction to return period, and risk
4.2 Flood prediction by Rational and Empirical methods

Unit 5: Introduction to Irrigation Engineering. **[2 Hrs]**

5.1 Definition, Need, and Objectives of Irrigation
5.2 Advantages and disadvantages of irrigation
5.3 Status of irrigation development in Nepal
5.4 Sources of irrigation water and types of irrigation system

Unit 6: Irrigation Water Requirements: **[8 Hrs]**

6.1 Types and Season of Crops
6.2 Crop Period, Base Period, Kor Period, and Kor Depth
6.3 Duty, Delta, and their Relationship
6.4 Commanded Area (GCA, CCA, NCA) and Irrigation Intensity
6.5 Soil-Moisture-Irrigation Relationship
6.6 Depth and Frequency of Irrigation
6.7 Irrigation Efficiencies
6.8 Crop Water Requirement
6.9 Water Losses due to Seepage and Evaporation
6.10 Effective Rainfall and Irrigation Water Requirement

Unit 7: Methods of Irrigation: **[4 Hrs]**

7.1 Surface Irrigation
7.2 Subsurface Irrigation
7.3 Sprinkler Irrigation
7.4 Drip or Trickle Irrigation

Unit 8: Canal Irrigation System and Design of Irrigation Canals: **[8 Hrs]**

8.1 Classification of Canals
8.2 Components of the Canal System
8.3 Alignment of Canals
8.4 Design concept of Alluvial and Non-Alluvial Canals (Manning's and Chezy' and Lacey's Theory).
8.5 Design of Non-Alluvial Canals (Manning's and Chezy's Formulae)
8.6 Design of Alluvial Canals (Lacey's and Kennedy's Theories)
8.7 Canal Lining and Design of Lined Canal
8.8 Cross-Section of Canals

Unit 9: Control and Regulatory Structures: **[4 Hrs]**

9.1 Layout, Components of Diversion Headworks
9.2 Bed Sediment Control Structures at Headworks
9.3 Cross-drainage Works
9.4 Canal Drops or Falls
9.5 Canal Head Regulator and Cross regulator
9.6 Canal Escapes
9.7 Canal Outlets

Unit 10: Irrigation Management: **[2 Hrs]**

10.1 Operation and Maintenance of Irrigation Works
10.2 Institutional Development of Irrigation Systems
10.3 Participatory Irrigation Management including FMIS

Tutorials: ***[15 Hrs]***

1. Unit 2: Estimation of Missing Rainfall Data, and Estimation of Mean Rainfall over an Area **[2 Hrs]**
2. Unit 4: Flood Risk, and Flood Prediction (Rational and Empirical Methods) **[2 Hrs]**
3. Unit 6: Duty, Delta, Depth and Frequency of Irrigation, Irrigation Efficiencies, Crop Water Requirement, and Irrigation Water Requirement **[5 Hrs]**
4. Unit 8: Design of canals (Non-alluvial, Alluvial, and Lined Canals) **[6 Hrs]**

Practical/Laboratory: ***[15 Hrs]***

1. Streamflow Measurement by Velocity Area Method (Current Meter and Floats)
2. One-day field visit at a Meteorological Station in the vicinity followed by a group presentation and submission of individual report
3. Field visit of an Irrigation System followed by a group presentation, and submission of individual report

References:

1. S K Garg, "Irrigation Engineering and Hydraulic Structures", Delhi, India
2. Gurcharan Singh, "Irrigation Engineering".
3. Bharat Singh, "Fundamentals of Irrigation Engineering", Nem Chand and Bros, India.
4. R S Varshney, S C Gupta and R L Gupta, "Theory and design of irrigation structures, volume I and II", Nem Chand and Bros, India.
5. K. Subramanya, "Engineering Hydrology", Tata-McGraw Hill Publishing Co., New Delhi, India.
6. B. L. Gupta, "Engineering Hydrology", Standard Publishers and Distributors, New Delhi.
7. K.N. Dulal and Sanjeeb Baral, "Engineering Hydrology", APEX Educational Academy, Putalisadak, Kathmandu, Nepal.
8. S. K. Garg, "lrrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Hydrology	2	4
2	Precipitation	7	10
3	Surface Runoff	8	10
4	Flood Hydrology	4	6
5	Introduction to Irrigation Engineering	2	2
6	Irrigation Water Requirements	13	18
7	Methods of Irrigation	4	4
8	Canal Irrigation System and Design of Irrigation Canals	14	20
9	Control and Regulatory Structures	4	4
10	Irrigation Management	2	2
	Total	**60**	**80**

Note: There might be a minor deviation on the above-specified marks.

Third Year
Part I & II
(Fifth and Sixth Semester)

Fifth Semester
Year III Part I

Subjects:

1 EG 3101 HE CAD and Construction Drawing
2 EG 3102 HE Estimating and Costing II
3 EG 3103 HE Structural Design and Drawing
4 EG 3104 HE Transportation Engineering
5 EG 3105 HE Water Supply and Sanitary Engineering
6 EG 3106 HE Hydropower Engineering I
7 EG 3107 HE Minor Project (Survey Camp)

CAD and Construction Drawing

EG 3201 HE

Year : III **Total : 5 Hrs/Week**
Part : I **Lecture : 1 Hrs/Week**
Tutorial : Hrs/Week
Practical : 4 Hrs/Week
Lab : Hrs/Week

Course Description:

This course provides students with a broad introduction into 2-dimensional and basic of 3-dimensional Computer-Aided Drawing and Drafting (CADD) with a focus on civil engineering drawings. This 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. Moreover, it also intends to impart skills on preparing drawings and sketches of construction details for building construction and construction of other structures and its implementation in field.

Course Objectives:

1. After the completion of this course student will be able to:
2. Introduce CAD software programs (Autodesk Auto CAD) to model construction projects
3. Create basic Civil and Architectural drawings;
4. Prepare setting out drawings for construction activities;
5. Prepare working drawings of different components of earthquake resistant buildings;
6. Prepare working drawing of engineering constructions;
7. Prepare basic 3-d objects;
8. Perform hand drawing.

Course contents:

Unit 1. Introduction to the Construction Drawing and CAD: **[2 Hrs]**

1.1 Overview of the type of drawings (Concept drawing, working drawing, Structural drawing and As-built drawing etc.)

2.1 Introduction to application software (especially CADD, Land Development software) and its installation.

3.1 Computer graphics fundamentals (raster object and vector application) data storage and retrieval, hierarchical storage system, introduction to basic graphical application, drawing exchange.

Unit 2. Starting a New Drawing/Opening an Existing Drawing: **[2 Hrs]**

2.1 Setting up a drawing, starting from scratch, using a Wizard, using an existing template file and creating a new template file.

2.2 Opening an existing drawing

2.3 Screen layout, pull-down menus, screen icons, command line and dialogue boxes, status bar toggles,

2.4 Setting preferences (Setting Units and Scale, managing drawing area by using MV setup and Limits, setting and use of drafting aids.
2.5 Saving Drawing in different formats (. dwg, dxf, dwt, pdf) and version of files.
2.6 Recovering Unsaved files.

Unit 3. Drawing Commands: **[4 Hrs]**

3.1 Co-ordinate input methods (absolute, relative, polar, and dynamic)
3.2 Point, Lines, Polyline, Multiline, Construction Lines
3.3 Circle, Arc, Ellipse, Donut
3.4 Polygon, Rectangle, Spline, Solids etc.
3.5 Hatching
3.6 Text (multi-line & single line / true type fonts
3.7 Dimension tools
3.8 Annotative Text and Dimensions

Unit 4. Modify Commands: **[1 Hr]**

4.1 Object selection
4.2 Real-time pan and Zoom
4.3 Erase, Trim, Break
4.4 Copy, Cut, Mirror, Offset, Array,
4.5 Move, Rotate, Scale, Stretch, Align
4.6 Lengthen, Extend,
4.7 Chamfer, Fillet, explode, break at point, joint etc.

Unit 5. Features: **[2 Hrs]**

5.1 View tools,
5.2 Layers concept, match and change properties.
5.3 Measure and divide
5.4 Inquiry commands (Id, Distance, Area, List, Mass property etc.
5.5 Working with Block, W-block and External References.
5.6 Drawing Exchange (convert to other format from drawing format and into drawing format)
5.7 Using drawing attributes, uses of predefined objects etc.
5.8 Uses of script files.
5.9 Use of Layout, and viewport to scale object and manage paper space.

Unit 6. Application of CADD in Civil Engineering Field: **[1 Hr]**

6.1 Land development and surveying,
6.2 CADD and Highway Engineering
6.3 CADD and Building Drawing
6.4 CADD with water supply and sanitary drawings

Unit 7. Basic use of 3-D modeling in AutoCAD **[2 Hrs]**

7.1 Overview of different 3-D planes and views.
7.2 Switching between 2-D and 3-D mode.

7.3 Changing UCS in 3-D mode.
7.4 Using Basic 3-D commands (Orbit, Extrude, Subtract and Slice)
7.5 Creating Basic 3-D objects (Box, Cylinder, and Cone etc.)
7.6 Creating Simple 3-D objects from 2-D objects (Round Table and extrude wall)

Unit 8. Plotters and Plotting the Drawing: **[1 Hr]**

8.1 Preparing a Drawing for Plotting or Printing
8.2 Creating a Layout in Paper Space
8.3 Plotting a Drawing

Practical /Laboratory: ***[60 Hrs]***

Unit 1. Starting a New Drawing/Opening an existing drawing **[2 Hrs]**

- Set up a drawing starting from scratch, using a Wizard, using and creating a template file, drafting aids.
- Open an existing drawing
- Prepare Screen layout, pull-down menus, screen icons, command line and dialogue boxes, toggles keys, Screen organization.
- Set preferences (Setting Units and Scale, managing drawing area by using MV setup and Limits.)
- Save drawing in different formats (. dwg, dxf, dwt, pdf) and versions of files.
- Recover unsaved files.

Unit 2. Drawing Commands **[5 Hrs]**

- Draw a rectangle using Co-ordinate input methods (directive, absolute, relative and polar)
- Draw Point, Lines, Polyline, Multiline, Construction Lines
- Draw Circle, Arc, Ellipse, Donut
- Draw Polygon, Rectangle, Spline, solids etc.
- Hatch Objects and areas between lines.
- Write Text (multi-line & single line / true type fonts)
- Give Dimensions to various objects (circle, line, rectangle, polygon etc.) using Dimensions tools.

Unit 3. Modify Commands **[2 Hrs]**

- Perform various Object selection methods.
- Apply: Erase, Trim, Break tools to modify the existing drawing.
- Apply: Copy, Mirror, Offset, Array tools to modify the existing drawing.
- Apply: Move, Rotate, Scale, stretch tools to modify the existing drawing.
- Apply: lengthen Extend commands to modify the existing drawing.
- Apply: Chamfer, Fillet, explode, and break at point and joint commands to modify the existing drawing.

Unit 4. Features **[3 Hrs]**

- Create Layers and perform match and change properties.

- Measure line and divide in parts
- Apply Inquiry commands
- Perform Drawing Exchange (convert to the other formats from one drawing format.)
- Use Layout, template and viewport to scale object and manage paper space.

Unit 5. Hand Drawing and Field Work: [30 Hrs]

- Prepare drawing plate/plates of a Single Storied R.C.C. building with three or more rooms per floor with reinforced concrete slab meeting the requirements of Nepal Building code (NBC).
- Prepare setting out plans for earth cutting and construction lines of building drawn in task 1 above.
- Practice staking out in the field of the plan prepared on task 2 above.
- Draw detail drawings of:
- Dog legged stair case (RCC)
- Door and Window frames including joints and fixing details
- Flush and panel door including joints and fixing details.
- Casement window including joints and fixing details.
- Prepare a roof plan and elevation with valleys for CGI, and RCC roofing materials including their construction details.
- Draw Racking, Flying and Dead shores with fixing details.
- Draw septic tank and soak pit including sanitary fittings details.

Unit 6. Application of CADD in Civil Engineering Field [12 Hrs]

- Draw a complete architectural drawing using CADD software (Location plan, Site plan, Floor plans, Elevations, Sections and detailed structural drawing) of a R.C.C. building, with three or more rooms per floor and two and half storey, following Nepal Building Code (NBC).
- Contour plotting with the help of SWDTM.
- Plotting Longitudinal and Cross section of the river using SWDTM

Unit 7. Basic use of 3-D modeling in AutoCAD [5 Hrs]

- Make 3-D drawing of a single-room rectangular shaped building with flat slab.

Unit 8. Plot and change the scale of drawing from model space and also from layout. [1 Hrs]

References:

1. Gurcharan Singh, "Civil Engineering Drawing", Standard Publishers distributers, India.
2. George Omura, "Mastering AutoCAD 2019 and AutoCAD LT 2019", SYBEX publisher
3. Elise Moss, "Autodesk AutoCAD 2019 Fundamentals, SDC Publications
4. Sushil Kumar, "Building Construction", Standard Publishers Distributers
5. B.C. Punmia, A.K. Jain, Arun Kr. Jain, "Building Construction", Laxmi publication
6. W.B. McKay, "Building construction, Vols. I – IV", ELBS, LONGMAN,
7. Shah, "Building Drawing with an Integrated Approach to Built Environment", Tata McGraw-Hill Education Pvt. Ltd
8. S. S. Bhavikatti and M. V. Chitawa Building Planning and Drawing", I K International Publishing House Pvt. Ltd.

Minimum Standard:

- A well – equipped computer lab.
- Drawing hall with all necessary tools and infrastructure which includes drawing tables, boards and etc.
- Setting out tools such as thread, pegs, hammer, level pipe, nails and set square etc.

Marking Scheme:

- Examination should be conducted on practical basis.
- Examination should be held in two shifts: each for construction drawing and AutoCAD drawing separately as following.

Topic	Internal	Final	Total
Construction drawing	50	25	75
Auto CAD	50	25	75
Total	**100**	**50**	**150**

Estimating and Costing II

EG 3102 HE

Year : III **Total: 6 Hrs/week**

Part : I **Lecture: 3 Hrs/week**

Tutorial: Hrs/week

Practical: Hrs/week

Lab: 3 Hrs/week

Course description:

This course focuses on familiarization of estimating and costing and specifications of road works and water supply and sanitary works and valuation of existing property.

Course objectives:

On completion of this course the student will be able to:

1. Understand the procedures, methods of measuring and quantifying the road and restoration work;
2. Calculate the quantities of earthwork of road in plain and hilly area;
3. Analyze rate of road and water supply and sanitations works;
4. Provide basic knowledge of the value of existing property and role of computes in valuation;
5. Provide basic knowledge of specifications of building and road works and
6. Prepare estimate of road and restoration works.

Course Contents:

Unit 1: Introduction: **[3 Hrs]**

1.1.Terms use in Earthwork in road construction

1.2.Method of estimating of road and restoration works

Unit 2: Earthwork in Road Construction: **[10 Hrs]**

2.1 Various methods of earthwork calculation in road work

2.2 Earthwork calculation of road work in plain area

2.3 Earthwork calculation of road work having vertical drop

2.4 Earthwork calculation of road work in highly area

Unit 3: Analysis of Rules (for road and sanitary and water supply): **[10 Hrs]**

3.1.Task or outturn work

3.2.Factors affecting the cost of road and sanitary and water supply works

3.3.Govt. procedure of preparing rate analysis of road and sanitary and water supply works

Unit 4: Valuation: **[10 Hrs]**

4.1.Definition

4.2.Purpose of valuation

4.3.Principle of valuation

4.4.Factors affecting the value of propose
4.5.Definition of terms used in valuation
4.6.Method of valuation
4.7.Method of writing valuation report

Unit 5: Specifications **[12 Hrs]**

5.1.Definition
5.2.Purpose of specification
5.3.Types of specification
5.4.Necessity of specification
5.5.Technique of specification
5.6.Paragraph of specification
5.7.Detailed specification for:

a) Building work:
- earthwork in excavation
- plain content concrete work
- steel reinforcement
- form work
- brick masonry work
- stone masonry work
- wood work for doors and windows frame and shutters
- cement sand plaster work
- CGI sheet roofing

b) Road works:
- embankment construction
- sub-grade
- base course
- WBM road
- surface dressing using hot bitumen
- premix carpet

Practical/Laboratory: ***[45 Hrs]***

Taking out detailed quantities and preparing estimate for the following:

1 Estimate two storey RCC framed structure building having a flat roof
2 Calculate earthwork in road construction by three methods
3 Calculate earthwork of road in plain area
4 Calculate earthwork of road having vertical drop
5 Calculate earthwork of road in highly area
6 Estimate metalled road of one KM
7 Evaluate report of existing properly
8 Estimate restoration work of road

References:

1. Amarjit Aggrawal "civil estimating quantity surveying and valuation, "Katson publishing house, Ludhiana,
2. M. Charkraborti "estimating, costing, specifications and valuation in civil engineering"
3. G. S. Berdie "text book of estimating and costing".

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	3	4
2	Introduction	10	18
3	Analysis of Rules (for road and sanitary and water supply)	10	18
4	Valuation	10	18
5	Specifications	12	22
Total		**45**	**80**

Note: There may be minor variation in marks distribution

Structural Design and Drawing

EG 3103 HE

Year: III **Total: 10 Hrs/week**
Part : I **Lecture: 5 Hrs/week**
Tutorial: 3 Hrs/week
Practical: Hrs/week
Lab: 2 Hrs/week

Course description:

This course provides the general ideas and design of RC members, steel and timber members using relevant codes of practice. After completion of this course, students must be able to supervise steel fabrication and construction, RC constructions and s/he should be able to design simple steel, timber and RC members and prepare detail drawings of reinforcements in foundation, columns, beams, slabs, sills, lintels and also able to prepare ductile detailing of beam-column joints, column bases and bar bending schedule.

Course objectives:

After the completion of this course, the students will be able to:

1. Identify and select proper materials, calculate the design values for the materials.
2. Understand concept of design and codal provisions and
3. Design simple steel, timber and RC structural elements by WSM.
4. Able to prepare the proper detailing of structural members (steel, timber and reinforcement) and their connections using NBC: 101, 102, 103, 104, 105, 110; IS: 875, IS800, IS 883:1994, IS: 456-2000 & 2016, SP-16, SP-34 & IS: 13920 and related codes of practice.

Course Contents:

Unit 1: Introduction **[4 Hrs]**

1.1 Introduction to steel structures
1.2 Types & properties of steel
1.3 Allowable stresses in structural steel
1.4 Use of steel as a structural member in construction
1.5 Codes of practice for design of steel structures
1.6 Advantage and disadvantage of steel structures

Unit 2: Joints in the Steel Structures and Their Design **[12 Hrs]**

2.1. Types of joints: Riveted, bolted and welded joints
2.2. Types of failure of riveted and bolted joints
2.3. Rivets value and efficiency of joints
2.4. Design of simple riveted joint under axial loads
2.5. Design of simple welded joints connection under axial loads.

Unit 3: **[8 Hrs]**

3.1. Introduction
3.2. Types of tension members
3.3. Net sectional area of tension members.
3.4. Design of simple tension members subjected to axial loads.

Unit 4: Axially loaded Compression Members (Tubular) and Angle Section [6 Hrs]

4.1. Introduction
4.2. End condition, Effective lengths and their buckling behavior.
4.3. Radius of gyration and slenderness ratio
4.4. Strength of compression members
4.5. Design of simple compressive members

Unit 5: Introduction to Roof Trusses [3 Hrs]

5.1. Different types of loads on roof truss
5.2. Introduction to the design of roof trusses:
5.3. Tubular sections

Unit 6: Timber Structures [2 Hrs]

6.1. Introduction of timber
6.2. Properties of timber
6.3. Use of timber as a structural member in construction
6.4. Factors affecting strength of timber.
6.5. Code of practice of design of timber structures
6.6. Advantage & disadvantage of timber structure

Unit 7: Design of Timber Structure [6 Hrs]

7.1. Design of compression member
7.2. Design of solid rectangular beam
7.3. Check of deflections
7.4. Types of joints and their connection

Unit 8: Design Concept of Reinforced Concrete [6 Hrs]

8.1. Concept of reinforced cement concrete (RCC) as composite material, role of reinforcement, requirements of materials, loads on structure as per NBC: 102, 103, 104, 106 & IS: 875.
8.2. Different grades of cement and steel. Properties of concrete and steel reinforcement (mild &HYSD bars), concept of characteristics strength, grades of concrete reinforcing bars.
8.3. Stress-Strain Diagram for concrete and steel
8.4. Different Methods of design of a reinforced concrete section: WSM, LSM,ULM
8.5. Behavior of reinforced concrete in bending
8.6. Concept of modular ratio, permissible and ultimate stress and factor of safety

Unit 9: Design Concept of Reinforced Concrete Beam by WSM [8 Hrs]

9.1. Introduction
9.2. Types of beams
9.3. Actual and critical neutral axis (NA)
9.4. Position of neutral axis
9.5. Moment of resistance
9.6. Under reinforcement, over reinforcement, and balanced sections
9.7. Analysis and design of singly and doubly reinforcement rectangular sections
9.8. Introduction to the Flanged beam.

Unit 10: Shear and Bonds for R.C. Sections **[6 Hrs]**

10.1. Shear behavior and mode of shear failure in RCC beam.
10.2. Shear resistance of reinforced section
10.3. Types of shear reinforcement
10.4. Strength of vertical links (stirrups)
10.5. Design of shear reinforcement in the form of vertical stirrups
10.6. Bond between concrete and steel reinforcement, types of bonds, bond stress
10.7. Development length in tension and compression anchorage value of hooks,90 bend and 45 bend.
10.8. Need for Bar curtailment

Unit 11: Design Concept of One Way and Two Way Slab by WSM **[6 Hrs]**

11.1. Introduction and classification of slabs.
11.2. Effective span of the slab, and different loads on slab
11.3. Design of One-way slab (Simply Supported).
11.4. Design of two-way slab.
11.5. Reinforcement detailing

Unit 12: Axial Loaded R.C. Columns **[8 Hrs]**

12.1 Short and long columns
12.2 Types of compression members
12.3 Modes of failure of RC Column
12.4 Design of a RCC rectangular column
12.5 Reinforcement detailing
12.6 Code requirements
12.7 Design concept of isolated footing.

Tutorial: ***[45 Hrs]***

1. Determination of rivets value and efficiency of joints.
2. Design of simple riveted joints under axial loads with joint details
3. Design of simple welded connections under axial loads with joint details
4. Determination of net sectional area of tension members and their capacity.
5. Design of members subjected to axial load: Simple
6. Design of simple compression timber members.
7. Design of simple flexural timber members.
8. Problems related to under reinforced, over reinforced and balanced sections in WSM.
9. Problems on design of shear reinforcement in the form of vertical stirrups. Check for minimum shear reinforcement.
10. Determination of development length and check.
11. Design of one-way slabs. Check for deflection and reinforcement requirement.
12. Design of two-way slabs
13. Design of axially loaded columns with lateral ties.

Practical/Laboratory: ***[30 Hrs]***

Design and draw followings:

1. Singly reinforcement rectangular beams
2. Doubly reinforcement rectangular beams
3. Singly reinforcement T – beams
4. One way slabs (simply supported)
5. Two way slab
6. Short and long columns (axially loaded)
7. Simple pad footings for columns
8. Preparation of bar bending schedule for all RC drawings
9. Details riveted and welded joints.
10. Steel beam column connection and column bases
11. Steel roof truss joint details
12. Timber roof truss joint details
13. Timber beam and column

**** Note: IS: 456, IS:800, IS:883 and steel table is allowed in the examination***.

References:

1. Rajan Suwal, "Design of Steel and Timber Structures", R & R Group, Kathmandu
2. P. Dayaratnam, "Design of Reinforced Concrete Structures", Oxford & IBH Publishing Company.
3. S. Negi, "Design of Steel & Timber Structures", Tata McGraw Hill Publishing Co., New Delhi.
4. Rajan Suwal, "Design of Reinforced Concrete Structures", A. K. Book Publication, Kathmandu
5. NBC 101, 102, 103, 104, 105, 111, 112, 113, other related codes and Nepal standards.
6. IS: 875 & 800 and related codes of practice.
7. IS: 456-2000 & 2016, SP-34 & IS 13920 and related codes of practice.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	4	4
2	Joints in the Steel Structures and Their Design	12	8
3	Design of Tension Members	8	8
4	Design of Tension Members	6	6
5	Axially loaded Compression Members (Tubular) and Angle Section	3	4
6	Timber Structures	2	4
7	Design of Timber Structure	6	8
8	Design Concept of Reinforced Concrete	6	6
9	Design Concept of Reinforced Concrete Beam by WSM	8	8
10	Shear and Bonds for R.C. Sections	6	6
11	Design Concept of One Way and Two Way Slab by WSM	6	10
12	Axial Loaded R.C. Columns	8	8
	Total	**75**	**80**

Note: There might be minor deviation in above specified marks.

Transportation Engineering

EG 3104 HE

Year: III **Total: 4 Hrs/week**

Part : I **Lecture: 3 Hrs/week**

Tutorial: Hrs/week

Practical: Hrs/week

Lab: 2/2 Hrs/week

Course description:

This course is aimed to provide general background knowledge road engineering putting emphasis on alignment survey, geometric design, drainage, highway materials, road pavement, road machineries, road construction technology, road maintenance and bridges.

Course objectives:

After the completion of this course, students will be able to:

1. Describe highway alignments and conduct its engineering survey;
2. Understand the principles of geometric design, both vertical and horizontal together with drainage components of highway;
3. Differentiate between the various types of materials used in road construction
4. Perform different test of road construction materials.
5. Differentiate between road pavement structures;
6. Know the different types of equipment used in road construction along with the road construction methodology depending upon the type of road surface.
7. Be familiar with different types of failures that may occur in road pavement after its operation and probable causes of failure.

Course Contents:

Unit 1: Introduction to Road Engineering **[3 Hrs]**

- 1.1. Introduction to road engineering
- 1.2. Road transport and its advantages/disadvantages
- 1.3. History of road development
  - 1.3.1 Roman roads construction technique
  - 1.3.2 Tresaguet road construction technique
  - 1.3.3 Telford road construction technique
  - 1.3.4 Macadam road construction technique
  - 1.3.5 Modern roads
- 1.4. Road construction in Nepal

Unit 2: Road Alignment and Engineering Survey **[3 Hrs]**

- 2.1. Introduction
- 2.2. Requirements of ideal road alignment
- 2.3. Factors controlling road alignment
- 2.4. Engineering survey for road alignment
  - 2.4.1. Map study
  - 2.4.2. Reconnaissance,
  - 2.4.3. Preliminary survey
  - 2.4.4. Final location and detailed survey

Unit 3: Road Geometric **[9 Hrs]**

3.1. Introduction
3.2. Road cross sectional elements
  3.3.1. Typical drawings of road cross sections: rural roads
  3.3.2. Camber
  3.3.3. Width of pavement or carriageway
3.3. Sight distance
  3.3.1. Introduction
  3.3.2. Types
  3.3.3. Analysis
3.4. Design of Horizontal alignment
  3.4.1. Horizontal curves
  3.4.2. Super elevation
  3.4.3. Extra widening on horizontal curves
  3.4.4. Horizontal Transition curve
3.5. Design of Vertical alignment
  3.5.1. Gradient
  3.5.2. Vertical curves

Unit 4: Road Drainage **[3 Hrs]**

4.1. Introduction and important of road drainage
4.2. Causes of moisture variation in subgrade soil
4.3. Requirements of good drainage system
4.4. Classification of road drainage system
  4.4.1. Surface drainage
  4.4.2. Subsurface drainage
  4.4.3. Cross drainage
  4.4.4. Energy dissipating structures
4.5. Surface drainage system (longitudinal drainage types like lined/unlined, rural/hill road drainage system)
4.6. Subsurface **Highway Materials** drainage system
4.7. Cross drainage structures

Unit 5: Highway Materials **[7 Hrs]**

5.1. Classification of highway materials
5.2. Subgrade soil
  5.2.1. Uses
  5.2.2. Requirements of soil as a highway material
  5.2.3. California Bearing Ratio test of soil
5.3. Stone aggregates
  5.3.1. Definition
  5.3.2. Types
  5.3.3. Desirable properties of road aggregates
  5.3.4. Tests on road aggregates (Los Angeles Abrasion test, Aggregate Impact test, Water absorption test, Specific Gravity test, Shape test)
5.4. Binding materials (bituminous material):
  5.4.1. Introduction

5.4.2. Types of binding materials (bitumen, tar), natural bitumen, petroleum bitumen, cutback bitumen, bituminous emulsion

5.5. Tests on bitumen: penetration test, ductility test, viscosity test, softening point test

Unit 6: **Road Pavement** **[2 Hrs]**

6.1. Definition, types, difference between flexible and rigid pavement

6.2. Different layers in pavement structure and their functions

Unit 7: Road Machineries **[2 Hrs]**

7.1.Methods of road construction (labor based, machine based)

7.2.Different types of tools, equipment and plants

7.2.1. Earth moving equipment

7.2.2. Grading equipment

7.2.3. Transporting equipment

7.2.4. Compacting equipment

7.2.5. Paving equipment and plants

Unit 8: Road Construction Technology **[7 Hrs]**

8.1. Introduction

8.2. Activities involved in road construction

8.3. Earthwork

8.4. Construction of earthen road: Introduction, materials required, equipment required, construction procedure

8.5. Construction of gravel roads: Introduction, materials required, equipment required, construction procedure

8.6. Construction of soil stabilized roads: Introduction to soil stabilization, types of soil stabilization, mechanical stabilization of soil (materials, equipment, construction procedure)

8.7. Constructions of Water Bound Macadam (WBM) roads: Introduction, materials required, equipment required, construction procedure

8.8. Construction of bituminous roads: Introduction, types of bituminous surfacing, interface treatment (prime coat, tack coat), seal coat, functions of each coat

8.9. Surface dressing: types (single, double), materials required, equipment required, construction procedure

Unit 9: Road Maintenance and Repair **[3 Hrs]**

9.1 Introduction

9.2 Types of maintenance activities

9.3 Maintenance of earth roads, gravel roads, WBM roads

9.4 Maintenance of bituminous roads (pot hole, patch repair works, resurfacing)

9.5 Maintenance of drainage structures

Unit 10: Bridge **[3 Hrs]**

10.1 Introduction

10.1.1 Definition

10.1.2 Classification based on span, length, loading, materials and structures

10.2 T Beam bridge

10.2.1 Essential elements

10.2.2 Detail of superstructure and substructure

10.3 Suspension bridge

10.3.1 Introduction

10.3.2 Components and their function

Unit 11: Hill Roads **[3 Hrs]**

11.1 Definition, importance of hill roads in Nepal

11.2 Design and construction problems in hill roads.

11.3 Special consideration of hill road geometric design: Temperature, Rainfall, Atmospheric pressure, Geological condition concept only

11.4 Typical cross sections of hill roads: drawing for concept only.

11.5 Special structures in hill roads like retaining walls, revetment walls, tow wall, slope protection works

Practical/Laboratory: ***[15 Hrs]***

1. Perform California bearing test of soil.
2. Perform Los Angles Abrasion test of aggregate
3. Perform penetration test of bitumen
4. Perform softening point test of bitumen
5. Perform ductility test of bitumen

References:

1. Dinesh Kumar Shrestha, Anil Marsani, "Transportation Engineering volume 1", Jasni Publications, Mid Baneshwor, Kathmandu, Nepal, 2013.
2. Partha Mani Parajuli, "Course Manual on Transportation Engineering I", IoE, Pulchowk, Lalitpur, Nepal.
3. C E G Justo, S K Khanna, "Highway Engineering", Khanna Publications, New Delhi, India
4. Ajay K Duggal, Vijaya P. Puri, "Laboratory manual on Highway Engineering", New Age International (P) Limited, New Delhi, India.
5. S. K. Sharma, "Principles, Practice and Design of Highway Engineering", S Chand and Company Ltd. New Delhi, India.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction to Road Engineering	3	4
2	Road Alignment and Engineering Survey	3	6
3	Road Geometric	9	16
4	Road Drainage	3	8
5	Road Drainage	7	14
6	Road Pavement	2	4
7	Road Machineries	2	4
8	Road Construction Technology	7	12
9	Road Maintenance and Repair	3	4
10	Bridge	3	4
11	Hill Roads	3	4
	Total	**45**	**80**

Note: There might be minor deviation in marks distribution

Water Supply and Sanitary Engineering

EG 3105 HE

Year: III **Total: 5 Hrs/week**
Part: I **Lecture: 3 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: 2/2 hour/week

Course description:

This course focuses on familiarization of fundamental of water supply engineering terminology, principle, system management, different component of workshop design and construction. The course also aims at developing fundamental knowledge of sanitary engineering such as sewerage system, preliminary sewage treatment system, on site sanitation systems and solid waste management.

Course objectives: Water supply

After the completion of this course, students will be able to:

1. Assess the various water consumption categories;
2. Describe the sources and methods of water collection;
3. Explain and illustrate water transmission and distribution systems;
4. Describe and illustrate pipe fittings, valves accessories and layout;
5. Carry out qualitative and quantitative analysis of water;
6. Understand an overview of the water treatment process and
7. Outline and sketch the water treatment process.

Course objectives: Sanitary

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

1. Understand the basic knowledge on sanitation and health, main diseases transmitted due to unsanitary excreta disposal;
2. Understand the basic knowledge on wastewater collection, conveyance, treatment and disposal methods and design of sewers;
3. Be familiar with the fundamental problems, issues related to wastewater and its management;
4. Describe the onsite sanitation systems and
5. Explain the importance and methods of solid waste disposal.

Course Contents: Theory

Part I: Water Supply Engineering

Unit 1: Introduction: **[2 Hrs]**

1.1 Water supply system and its importance.
1.2 Present status of water supply in Nepal.
1.3 Components of water supply system (Rural and Urban)

Unit 2: Sources of Water Supply: **[3 Hrs]**

2.1 Surface Sources: River, Streams, Pond, Lake, Impounded reservoir
2.2 Ground Sources: Springs, Wells - artesian and tube wells, Infiltration galleries
2.3 Alternative Water Source: Rain Water Harvesting

Unit 3: Quantity of Water: **[3 Hrs]**

3.1 Per capita consumption
3.2 Type of water demand: domestic, livestock, commercial, industrial and public uses, firefighting and losses and wastage
3.3 Design period: definition, factors affecting design period (selection basis)
3.4 Population forecasting: necessity and methods
3.5 Variation in water demand: types of variation, average demand, peak demand, factors affecting water demand
3.6 Numerical exercise on population forecasting, total water demand computation

Unit 4: Quality of Water: **[4 Hrs]**

4.1 Wholesome Water, Contaminated Water
4.2 Impurities in water, their classification and effects
4.3 Hardness in water, types of hardness, alkalinity in water
4.4 Living organisms in water: virus, algae, worms and bacteria
4.5 Water sampling and storing
4.6 Physical analysis (temperature, color, turbidity, taste and odour)
4.7 Chemical analysis (total solids, pH, chlorine)

Unit 5: Treatment of Water: **[8 Hrs]**

5.1 Screening: coarse and fine screens
5.2 Plain Sedimentation: purpose, types of sedimentation tank
5.3 Sedimentation with coagulation: purpose, process
5.4 Methods of aeration
5.5 Filtration: purpose; theory of filtration, types of filter; slow and rapid sand filter
5.6 Disinfection: purpose, methods of disinfection
5.7 Chlorination: residual chlorine, break point chlorination
5.8 Softening: removal of temporary hardness by boiling and lime treatment, removal of permanent hardness by lime soda and zeolite or ionization process
5.9. Arsenic water treatment.

Unit 6: Gravity Water Supply System: **[3 Hrs]**

6.1 Concept of gravity water supply
6.2 Schematic diagram of a typical gravity water supply system
6.3 Break pressure tank
6.4 Valves (flush out valve, air relief valve, gate valve)
6.5 Public tap stand post.
6.6 Supply of water from water main to household.
6.5 Residual head requirement

Part II: Sanitary Engineering

Unit 7: Introduction: **[3 Hrs]**

7.1. Sanitation and its present status in Nepal
7.2. Main diseases transmitted by unsanitary excreta disposal

7.3. Transmission routes
7.4. Preventive measures
7.5. Sewerage systems and types
    7.5.1. Separate system
    7.5.2. Combined system
    7.5.3. Partially separate system
    7.5.4. Comparison in tabular form between separate and combined systems

Unit 8: Quantity of Sewage: [2 Hrs]

8.1. Sources of sanitary sewage
8.2. Dry Weather Flow (DWF) and Wet Weather Flow (WWF)
8.3. Factors affecting quantity of sanitary sewage
8.4. Numerical on determination of quantity of wastewater for separate, combined and partially separate systems

Unit 9: Wastewater Disposal: [4 Hrs]

9.1. Necessity and objectives of wastewater disposal
9.2. Wastewater disposal by Dilution process and essential conditions for dilution
9.3. Self-purification of rivers/streams and sag curve
9.4. Wastewater disposal by land treatment and Suitability of land treatment
9.5. Methods of application of sewage on land - flooding, surface irrigation, ridge and furrow method, subsurface irrigation and spray irrigation
9.6. Sewage sickness and its prevention

Unit 10: Wastewater Treatments: [6 Hrs]

10.1. Objectives of wastewater treatment
10.2. Primary treatment process
    10.2.1. Racks and Screens - purpose, design criteria, construction and working
        10.2.1.1 Skimming tank – purpose, design criteria, construction, and working
    10.2.2. Grit chamber - purpose, design criteria, construction, and working
10.3. Waste stabilization pond - purpose , design criteria, construction and working
10.4. Constructed wetland - purpose, design criteria, construction and working

Unit 11: On site Sanitations for Isolated / Unsewered Area: [3 Hrs]

11.1. Necessity
11.2. Pit privy - purpose and construction
11.3. Ventilated Improved Pit (VIP) latrine - purpose, construction, design criteria
11.4. Septic tank - purpose, construction, design criteria and working
11.5. Soak pit - purpose, construction and design criteria

Unit 12: Solid Waste Disposal: [4 Hrs]

12.1. Importance of solid waste disposal
12.2. Collection, segregation and transportation methods
12.3. Methods of solid waste disposal
    12.3.1. Dumping
    12.3.2. Sanitary landfill
    12.3.3. Incineration
    12.3.4. Composting
    12.3.5 Energy generation

Tutorials: Water Supply ***[7.5 Hrs]***

Unit 1: Introduction: **[0.5 Hrs]**
Definition and schematic diagram of components of water supply system.

Unit 2: Sources of Water Supply: **[0.5 Hrs]**
Definition and types of water supply system with its importance.

Unit 3: Quantity of Water: **[1.5 Hrs]**
Definitions and Numerical exercise on population forecasting, total water demand computation.

Unit 4: Quality of Water: **[1.5 Hrs]**
Definitions and standard of quality of water.

Unit 5: Treatment of Water: **[2 Hrs]**
Definition and drawing of sedimentation tank, slow sand filter and rapid sand filter.

Unit 6: Gravity Water Supply System: **[1.5 Hrs]**
Definition and drawing of Storage tank(RVT), Break pressure tank, Tap stand and Layout of distribution system.

Tutorials: Sanitation ***[7.5 Hrs]***

Unit 7: Introduction **[0.5 Hr]**
Definitions

Unit 8: Quantity of Wastewater **[1.5 Hrs]**
Definitions, Numerical on determination of sanitary sewage and storm water, determination on quantity of wastewater for separate, combined and partially separate systems

Unit 9: Wastewater Disposal **[0.5 Hr]**
Definitions, drawing sag curve

Unit 10: Wastewater Treatment **[2.5 Hrs]**
Numerical on design of Racks and Screens, Skimming tank, Grit chamber

Unit 11: Disposal of Sewage from Isolated Buildings **[2 Hrs]**
Definitions, Numerical on design of VIP latrine, Pour flush latrine, Septic tank and Soak pit

Unit 12: Solid Waste Disposal **[0.5 Hr]**
Definitions, purpose, classification

Practical/Laboratory: ***[15 Hrs]***

1. Determine physical parameters (Colour, Turbidity, Temperature)
2. Determine pH value
3. Perform jar test
4. Determine total solids
5. Determine dissolved oxygen

References:

1. Birdie, G.S. and Birdie, J.S, "Water Supply and Sanitary Engineering", Dhanapat Rai & Sons Publishers, Nai Sarak, Delhi- 110006, India.
2. B. C. Punmia, A. Jain, Water Supply Engineering", Laximi Publications (P) Ltd, New Delhi
3. R. Barry, "The Construction of Building (Volume 4) Building Services", Affiliated East-west Press Pvt. Ltd., New Delhi
4. P.N. Modi, "Sewage Treatment & Disposal and Wastewater Engineering", Standard Book House, Delhi, India.
5. G. S. Birdie and J, S, Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, India.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction (Water Supply Engineering)	2	4
2	Sources of Water Supply	3	6
3	Quantity of Water	3	6
4	Quality of Water	4	8
5	Treatment of Water	8	12
6	Gravity Water Supply System	3	6
7	Introduction (Sanitary Engineering)	3	4
8	Quantity of Sewage	2	4
9	Wastewater Disposal	4	8
10	Wastewater Treatments	6	10
11	On site Sanitations for Isolated / Unsewered Area	3	4
12	Solid Waste Disposal	4	8
	Total	**60**	**80**

Note: There might be minor deviation in marks distribution.

Hydropower Engineering I
EG 3106 HE

Year: III **Total: 6 Hrs/week**
Part: I **Lecture: 4 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: 2/2 Hrs/week

Course description:
The course focuses on the different civil components of RoR and the Storage Hydropower Schemes. It helps students to layout hydropower stations, and estimate power and energy.

Course Objectives:
After completion of this course students will be able to:
1. Understand hydropower development issues
2. Search for different possible layout options for a hydropower potential area
3. Know components of RoR and Storage Schemes and Their Basic Design Principle
4. Draw the typical layout of RoR and Storage plants

Course Contents:

Unit 1: Introduction [6 Hrs]
- 1.1 Energy and its sources, Present Scenario of Energy Consumption in Nepal.
- 1.2 Brief Historical Background of Power development in Nepal
- 1.3 Organizations involved in hydropower development in Nepal at present
- 1.4 Hydropower Potential in Nepal (Gross, technical and economic potentials)
- 1.5 Hydropower Development Policy of Nepal.
- 1.6 Challenges of Hydropower Development in Nepal.

Unit 2: Planning of Hydropower Projects [10 Hrs]
- 2.1 Types of Hydropower plants based on head, storage, and capacity.
- 2.2 Stages of hydropower development: Reconnaissance, Pre-feasibility study, Feasibility study, and detailed engineering design and data requirement
- 2.3 General layout and major components of i) micro-hydro ii) RoR iii) Peaking RoR and iv) storage hydropower Projects with examples
- 2.4 Reliability of Flow and Flow Duration Curve [FDC]
- 2.5 Introduction to Sediment Analysis and its importance in Design of RoR and Storage Projects

Unit 3: Power and Energy Potential Study [8 Hrs]
- 4.1 Gross and Net Head and Estimation with and without Draft Tube.
- 4.2 Different types of Efficiencies: Conveyance, Turbine, Generator, Transformer and Overall Efficiency
- 4.3 Estimation of Power and Energy potential
- 4.4 Fixing Installed Capacity of a Hydropower Plant Using Flow Duration Curve
- 4.5 Mean and peak load, load curve, load factor, diversity factors, and plant factor

Unit 4: Headwork of Storage Plants **[12 Hrs]**

4.1 Dam Engineering
- 7.1.1 Types of dam based on materials, function, and head
- 7.1.2 Dam site evaluation and selection of the type of dam
- 7.1.3 Loads on the dam and their combination
- 7.1.4 Failure modes of concrete and embankment dams and their remedies
- 7.1.5 Gravity (concrete) dam stability analysis (overturning, sliding)

4.2 Intake: Typical arrangement of Dam Intake

4.3 General Introduction of Spillways and Energy Dissipaters

Unit 5: Headworks of Run-of-River (RoR) Plants **[12 Hrs]**

5.1 General requirements of a functional RoR headworks

5.2 Intakes of RoR Headworks: Location, Control of bedload and floating debris, and intake types

5.3 Gravel Trap and its Working Principle

5.4 Settling Basin, its purpose, design (particle approach), and types

Unit 6: Water Conveyance Structures **[10 Hrs]**

6.1 Canal (canal sizing, permissible velocity, head loss)

6.2 Tunnel (geometrical shapes, head loss)

6.3 Forebay and Surge Tanks: importance, typical arrangement

6.4 Penstocks: importance, general arrangement, hydraulic transients (water hammer), thickness estimation

6.5 Anchor blocks and support piers.

Unit 7: Powerhouse **[2 Hrs]**

7.1 Introduction

7.2 Type of powerhouse (surface, semi-underground, underground), general arrangement (typical plan and section)

Tutorial: ***[15 Hrs]***

1. Unit 3: Estimation of power and energy, mean and peak load, load curve, load factor, diversity factors, and plant factor **[4 Hrs]**
2. Unit 4: Gravity (concrete) dam stability analysis (overturning, sliding) **[5 Hrs]**
3. Unit 5: Settling Basin design (particle approach) **[2 Hrs]**
4. Unit 6: Hydraulic transients (water hammer), penstock thickness estimation **[4 Hrs]**

Practical/Laboratory: ***[15 Hrs]***

1. Preparation of alternative layouts of a ROR plant on a given topographical map and assessing the most favorable one.
2. Preparation of section of each alternative layout
3. Estimation of long-term flow hydrograph and FDC
4. Estimation of power and annual energy
5. Preparation of the general layout of headworks of a RoR plant using CAAD.
6. Preparation of typical layout, sections, and elevations of a powerhouse using CAAD.

Excursion:

- One-day observation trip to a hydropower plant in the vicinity followed by a group presentation and individual field report

References:

1. Dandekar and Sharma, "Water Power Engineering", Vikas Publishing house, New Delhi
2. Novak, P. et al., "Hydraulic Structures", Taylor and Francis, London
3. E. Mosonyi, "Water Power Development, Volume 1: Low-head Hydropower Plants", Academia Kiado, Budapest
4. E. Mosonyi, "Water Power Development, Volume 2: High-head Hydropower Plants", Academia Kiado, Budapest
5. Warnick CC et al, "Hydropower Engineering", Prentice Hall, Inc, Englewood Cliffs, NJ
6. SK Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi
7. Hydropower Development- Series (17 Volumes), Vol. 8, 9, 10, 12,13, 14, Norwegian University of Science and Technology (NTNU), Norway
8. Sanjib Baral, "Fundamentals of Hydropower Engineering", Engineering and Education Services Pvt. Ltd., Kathmandu, Nepal

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Introduction	6	6
2	Planning of Hydropower Projects	10	10
3	Power and Energy Potential Study	12	12
4	Headwork of Storage Plants	17	16
5	Headworks of Run-of-River (RoR) Plants	14	16
6	Water Conveyance Structures	16	16
7	Powerhouse	2	4
	Total	**75**	**80**

Note: There might be a minor deviation on the above-specified marks.

Minor Project (Survey Camp)
EG 3107 HE

Year: III **Total: 4 Hrs/week**
Part: I **Lecture: Hrs/week**
Tutorial: Hrs/week
Practical: 4 Hrs/week
Lab: Hrs/week

Course description:

This course is designed to equip students with hands on practice on field survey of different survey techniques. The duration of this programme will be not less than 7 days (60 Hrs).

Objectives:

After completion of this course students will be able to:

1. Provide an ample opportunity to consolidate and update their practical and theoretical knowledge in surveying, with facing actual field conditions and problems and
2. Provide real field based exposure to learn and apply different surveying methods, modern surveying instruments, computational practices, and ways of presentation of their final reports including plotting.

Course Contents:

A. Topographic Surveying: **[4 Days]**

Conduct horizontal control practices around 2 hectares of land (about **8** control points) with semi built up area. Closed traverse as major traverse and at least one linked traverse as minor traverse must be made and detailed topographic survey must be conducted within the periphery of that area. Coordinates (XYZ) of these traverses including details must be controlled by using theodolite, total station and auto level.

1. Instrument for Horizontal Control: Theodolite and Total Station

For major traverse:

2set horizontal angles
Angular Accuracy =1'√n
Linear accuracy: 1:2000
Plotting scale: 1:500

For Minor Traverse:

1set horizontal angles
Angular Accuracy =1.5'√n
Linear accuracy: 1:1000
Plotting scale: 1:500

Allowable difference between FL and FR observations = 180^0 ±2 *Least Count

2. Instrument for Vertical control: Auto level
   Vertical control for control points must be done by fly leveling using auto level.
   Leveling miss closure: $25\sqrt{K}$ mm, where K = Circuit distance in Km

3. Detailing by: Theodolite and Total Station

B. **Bridge Site Survey: [1.5 days]**

Conduct triangulation survey for horizontal control. Conduct detailed topographic survey of bridge site area (125m *90m) to produce topographic map, L- section, X section etc.

Plotting scale:
Topographic Map: 1:200 or 1:500
L section: H- scale: 1:1000, V- scale 1:100
X section: H= V scale: 1:200
No of triangulation stations not more than 6
Coverage Area: Upstream 75m and downstream 50m from propose bridge axis& side width 30 m on either side of river bank.
Allowable angular accuracy = $\pm 1.5'\sqrt{n}$
One set horizontal angle observations with FL and FR difference of $180^0 \pm$ 2*Least Count
Conduct reciprocal leveling and fly leveling for vertical control.
Allowable accuracy = $\pm 25\sqrt{K}$ mm

C. Road Alignment Survey: [1.5 Days]

Perform at least **300m** road alignment survey and plot plan, L section, X section etc at standard scale.
Establish BC, MC and EC while setting out of horizontal curves, and compute chainages.
L sectioning data must be taken by auto level at 15m regular interval with plus stations if necessary.
X sectioning data must be taken up to 10m left and 10m right from centre line.

Plotting scale:
Plan: 1:500
L- sectioning: H scale: 1:1000, V scale: 1:100
X sectioning: H and V scale: 1:200
Design of formation level and Earth work Calculation

Requirements:
As far as possible, no of students for each group should not be more than 5 (five).

Evaluation Scheme:

Internal Assessment:

Continuous assessment throughout the 7 days as well as viva for computation and plotting of traverse, viva for road and bridge site survey should be taken. The weightage of internal assessment will be 60% (60 marks).

Final Assessment:

Each group must submit survey camp report in standard format. During compilation of report, data must be submitted content wise including reference sketches and standard drawings must be compiled in A**3** size. Original data and drawings must be presented during final viva voce. The weightage of final assessment will be 40% (40 marks).

Sixth Semester
Year III Part II

Subjects:

1 EG 3201 ME Entrepreneurship Development
2 EG 3201 HE Construction Management
3 EG 3202 HE Estimating and Costing III
4 EG 3203 HE Hydropower Engineering II
5 EG 3204 HE Major Project
6 Elective (one of the followings)
EG 3205 HE.1 a: Micro Hydro
EG 3205 HE.2 b: Hydropower Structure
EG 3205 HE.3 c: Energy Management
EG 3205 HE.4 d. Basics of GIS

Entrepreneurship Development

EG 3201 MG

Year: III **Total: 5 Hrs. /week**
Semester: II **Lecture: 3 Hrs./week**
Tutorial: Hr./week
Practical: 2 Hrs./week
Lab: Hrs./week

Course Description:
This course is designed to provide the knowledge and skills on formulating business plan and managing small business. The entire course deals with assessing, acquiring, and developing entrepreneurial attitude; skills and tools that are necessary to start and run a small enterprise.

Course Objectives:
After completion of this course students will be able to:

1. Understand the concept of business and entrepreneurship;
2. Explore entrepreneurial competencies;
3. Analyze business ideas and viability;
4. Learn to formulate business plan with its integral components and
5. Manage small business.

Course Contents:

Theory

Unit 1: Introduction to Business & Entrepreneurship: [9 Hrs.]

1.1 Overview of entrepreneur and entrepreneurship
1.2 Wage employment, self- employment and business
1.3 Synopsis of types and forms of enterprises
1.4 Attitudes, characteristics & skills required to be an entrepreneur
1.5 Myths about entrepreneurs
1.6 Overview of MSMEs (Micro, Small and Medium Enterprises) in Nepal

Unit 2: Exploring and Developing Entrepreneurial Competencies: [9 Hrs.]

2.1 Assessing individual entrepreneurial inclination
2.2 Assessment of decision-making attitudes
2.3 Risk taking behavior and risk minimization
2.4 Creativity and innovation in business
2.5 Enterprise management competencies

Unit 3: Business identification and Selection: [4 Hrs.]

3.1 Sources and method of finding business idea(s)
3.2 Selection of viable business ideas
3.3 Legal provisions for MSMEs in Nepal

Unit 4: Business plan Formulation: **[18 Hrs.]**

4.1 Needs and importance of business plan

4.2 Marketing plan

- Description of product or service
- Targeted market and customers
- Location of business establishment
- Estimation of market demand
- Competitors analysis
- Estimation of market share
- Measures for business promotion

4.3 Business operation plan

- Process of product or service creation
- Required fix assets
- Level of capacity utilization
- Depreciation & amortization
- Estimation office overhead and utilities

4.4 Organizational and human resource plan

- Legal status of business
- Management structure
- Required human resource and cost
- Roles and responsibility of staff

4.5 Financial plan

- Working capital estimation
- Pre-operating expenses
- Source of investment and financial costs
- Per unit cost of service or product
- Unit price and profit/loss estimation of first year

4.6 Business plan appraisal

- Return on investment
- Breakeven analysis
- Risk factors

Unit 5: Small Business Management: **[5 Hrs.]**

5.1 Concept of small business management

5.2 Market and marketing mix

5.3 Basic account keeping

Practical

Unit 1: Overview of Business & Entrepreneurship [2 Hrs.]

1. Collect business information through interaction with successful entrepreneur

Unit 2: Exploring and Developing Entrepreneurial Competencies [2 Hrs.]

1. Generate innovative business ideas

Unit 3: Product or service Identification and Selection [2 Hrs.]

1. Analyze business ideas using SWOT method

Unit 4: Business Plan Formulation [22 Hrs.]

1. Prepare marketing plan
2. Prepare operation plan
3. Prepare organizational and human resource plan
4. Prepare financial plan
5. Appraise business plan
6. Prepare action plan for business startup

Unit 5: Small Business Management [2 Hrs.]

1. Prepare receipt and payment account
2. Perform costing and pricing of product and service.

3. Construction Management

EG 3201 HE

Year: III **Total: 5 Hrs/week**
Part: II **Lecture: 4 Hrs/week**
Tutorial: 1 Hrs/week
Practical: Hrs/week
Lab: Hrs/week

Course description:

This course focuses on management of construction works. This course imparts knowledge on organization, Management, labor relations, safety, procurement of works, contract management, planning, scheduling, monitoring and control, and managing construction works and different construction equipment.

Course objectives:

After completion of this course students will be able to:

1. Describes Construction Management
2. Acquire basic knowledge on management of construction works;
3. Plan and schedule different activities of construction project;
4. Plan and schedule resources required in construction project and
5. Familiarize with monitoring and controlling, labor relations, and safety in construction works, and different construction equipment.
6. Understand basic knowledge of procurement/contract management.

Course Contents:

Unit 1: Introduction: **[4 Hrs]**

5.1 Definition and needs and types of organization.
5.2 Definition of Management
5.3 Definition of Project and its characteristics
5.4 Projects life cycles
5.5 Definition and Need of Construction Management
5.6 Functions of Construction Management
5.7 Relation between Owner, Consultant, and Contractor

Unit 2: Project Planning and Scheduling: **[12 Hrs]**

2.1 Definition of Planning
2.2 Steps in Planning
2.3 Importance of Planning
2.4 Construction Site Planning/Job layout
2.5 Factors affecting job layout.
2.6 Storage of materials and Material Handling System
2.7 Work Breakdown Structure and its importance.

2.8 Bar Chart with advantages and disadvantages, Linked Bar Chart, and Milestone Bar Chart
2.9 Definition of Scheduling, Preparation of Construction Schedule and its advantages
2.10 Preparation of Schedule of Resources (Material/Labor/Equipment and Finance)
2.11 Types of cost: Direct cost, Indirect Cost
2.12 Time cost trade off.

Unit 3: CPM and PERT: [14 Hrs]

3.1 Introduction to CPM
3.2 Elements of Network
3.3 Network Rules
3.4 Definition of the Terms: Network Diagram, Activity, Event, Forward Pass, Backward Pass, Critical Path
3.5 Determination of Critical Paths and Floats
3.6 Introduction to PERT

Unit 4: Procurement Process and Contract Administration: [8 Hrs]

4.1 Procurement Planning
4.2 Definition of Contract
4.3 Essentials elements of a Valid Contract
4.4 Types of Contracts: Unit Price Contract/Lump Sum Contract/Cost Plus Contract
4.5 Definition of Tender Notice, Information to be given in Tender Notice
4.6 Tender Document
4.7 Bid Bond and Performance Bond
4.8 Contract Document
4.9 Conditions of Contract
4.10 Award of contract

Unit 5: Site Management: [6 Hrs]

5.1 Supervising Work of a Contractor
5.2 Duties and Responsibilities of a Site Supervisor
5.3 Maintenance and its types.
5.4 Site Order Book
5.5 Materials at Site Account
5.6 Muster Roll
5.7 Measurement Book
5.8 Running Bill and Final Bill
5.9 Completion Report

Unit 6: Monitoring, and Quality Control: [6 Hrs]

6.1. Introduction to Monitoring
6.2. Purpose of Monitoring
6.3. Definition of Quality
6.4. Characteristics of Quality
6.5. Factors affecting Quality
6.6. Elements of Control: Quality, Cost, and Time
6.7. Stages of Quality Control

Unit 7: Construction Equipment: **[6 Hrs]**

7.1. Advantages of using Construction Equipment
7.2. Equipment for Excavation
7.3. Equipment for Concrete Mixing
7.4. Equipment for Transportation and Compaction
7.5. Equipment for Lifting of Materials and Parts
7.6. Introduction to the TBM
7.7. Introduction to Shotcrete machine

Unit 8: Safety and Labor Relation: **[4 Hrs]**

8.1. Introduction to Accidents
8.2. Causes of Accidents
8.3. Importance of Safety
8.4. Safety Measures
8.5. Meaning and purposes of labor Union
8.6. Labor act 2074

Tutorial Works: ***[15 Hrs]***

1. Preparation of different bar chart [5 Hrs]
2. CPM and PERT [10 Hrs]

References:

1. R. P. Adhikari, "Construction Management".
2. S.K Shrestha and I. Adhikari, "A text book of Project Engineering", Chandeswori Publication.
3. S.M. Shrestha and S. Shrestha, "Management-I", Akshalok Prakashan, Kathmandu, Nepal.
4. D. Bhattarai, "Construction Plant Management". P.U. Printers Battisputali, Kathmandu, Nepal.
5. K. Chitkara, "Construction Project Management". Tata McGraw-Hill Education Private Limited, New Delhi, India
6. B.N. Dutta, "Estimating and Costing".
7. D.A. DeCenzo and S.P. Robbins, "Personnel/Human Resource Management", Prentice-Hall of India, New Delhi.

Marks specification for final examination

Unit	Content	Course Hours	Mark
1	Introduction	4	08
2	Project Planning and Scheduling	17	12
3	CPM and PERT	24	16
4	Procurement Process and Contract Administration	8	12
5	Site Management	6	8
6	Monitoring, and Quality Control	6	8
7	Construction Equipment	6	8
8	Safety and Labor Relation	4	8
	Total	**75**	**80**

Note: There might be minor deviation on final mark distribution.

Estimating and Costing-III

EG 3202 HE

Year: III **Total: 6 Hrs/week**

Part: II **Lecture: 3 Hrs/week**

Tutorial: hour/week

Practical: Hrs/week

Lab: 3 Hrs/week

Course description:

This course focuses on familiarization of estimating and costing. It also deals with the specifications of sanitary, water supply and irrigation works.

Course objectives:

After completion of this course students will be able to:

1. Understand the procedures methods of measuring and quantity of irrigation, water supply and sanitary, culvert and RCC T beam decking works and hydropower components;
2. Analyze rates for irrigation, hydropower, water supply and sanitary;
3. Provide the basic knowledge of specification for water supply and sanitary and irrigation works
4. Prepare the cost estimate relating to irrigation, water supply, sanitary and hydropower works

Course Contents:

Unit 1: Method of Estimating: [10 Hrs]

1.1. Water supply and sanitary works
1.2. Irrigation works
1.3. Culvert and RCC T- beam decking
1.4. Hydropower components (weir, side intake, gravel trap, settling basin)

Unit 2: Analysis of Rate for Irrigation, Water Supply and Sanitation [10 Hrs]

2.1 Factors affecting the cost of irrigation, water supply and sanitary works
2.2 Government procedure of preparing analysis or rate for irrigation, water supply and sanitary works.

Unit 3: Analysis of Rate for Hydropower [10 Hrs]

3.1 Factors affecting cost of hydropower works
3.2 Government procedure for preparing analysis of rates for hydropower works

Unit 4: Specifications: [15 Hrs]

4.1 WC pan with cistern
4.2 Supplying and laying PVC pipe and fittings
4.3 Canal lining
4.4 Hume pipe
4.5 Penstock pipes
4.6 Expansion Joints
4.7 Valves (spherical, butterfly)
4.8 Turbines (Francis, Pelton, Kaplan)
4.9. Gates (Vertical, radial)
4.10. Trash rack

Practical/Laboratory: ***[45 Hrs]***

Take out detailed quantities and prepare estimate for the followings:

1. Estimate earthwork in channel/canal
2. Estimate canal lining
3. Estimate sewer line, manholes and surface drain
4. Estimate slab culvert
5. Estimate RCC T-beam decking
6. Estimate aqueduct structure
7. Estimate slow sand filter
8. Estimate of side intake
9. Estimate of gravel trap
10. Estimate of settling basin
11. Estimate of penstock pipe

References:

1. Amarjit Aggarwal "Estimating civil quantity surveying and valuation" katson publishing house, ludhiyana, India.
2. G.S. Berdie "Test book of estimating and costing"
3. M. Chakraborti "Estimating, costing, specification and valuation in civil engineering"
4. B.N. Dutta "Estimating and costing, specification and valuation"
5. P. Novak, et al., "Hydraulic Structures", Taylor and Francis, London
6. E. Mosonyi, "Water Power Development, Volume 1: Low-head Hydropower Plants", Academia Kiado, Budapest
7. E. Mosonyi, "Water Power Development, Volume 2: High-head Hydropower Plants", Academia Kiado, Budapest
8. CC Warnick et al., "Hydropower Engineering", Prentice Hall, Inc, Englewood Cliffs, NJ
9. SK Garg, "Irrigation Engineering and Hydraulic Structures", KhannaPublishers, New Delhi
10. Hydropower Development- Series (17 Volumes), Vol. 8, 9, 10, 12,13, 14, Norwegian University of Science and Technology (NTNU), Norway
11. Sanjib Baral, "Fundamentals of Hydropower Engineering",Engineering and Education Services Pvt. Ltd.

Marks specification for final examination:

Unit	Content	Course Hours	Marks
1	Method of Estimating	10	18
2	Analysis of Rate for Irrigation, Water Supply and Sanitation	10	18
3	Analysis of Rate for Hydropower	10	18
4	Specifications	15	26
	Total	**45**	**80**

Note: There might be minor deviation in marks distribution

Hydropower Engineering II

EG 3203 HE

Year: III **Total: 8 Hrs/week**
Part: II **Lecture: 4 Hrs/week**
Tutorial: 2 Hrs/week
Practical: Hrs/week
Lab: 2 Hrs/week

Course Description:

The Course deal with hydro-electro-mechanical system in hydroelectric power plant. Working principle and purposes of major electrical components and mechanical components are explained. The basic repairing and maintenance of major components are also covered on the last chapter.

Course Objectives:

After completing the course, students are able to:

1. Choose the supply system AC or DC.
2. Explain Synchronous generator
3. Explain AVR (Automatic Voltage Regulator), Exciter system.
4. Know the Switchgear Protection.
5. Calculate simple losses the Transmission line and Distribution line
6. Know the Penstock Joining, Penstock Support and Anchor, valves sizing
7. Understand the operation of different type of turbines and selection
8. Understand the working of Drive system and Governor
9. Gain skill on basics of repair and maintenance (Electro-Mechanical system in Power house)

Course Contents

Unit 1: Hydro-Electro-Mechanical Components **[2 Hrs]**

1.1 Typical Layout of Hydro-Electro-Mechanical Components
1.2 Hydro-Mechanical Components and their purposes
1.3 Electrical Components and their purposes

Unit 2: Choosing the Supply AC or DC System **[4 Hrs]**

2.1 Battery Charging system in hydro power
2.2 AC system versus DC battery charging system
2.3 DC system using an inverter to supply AC load in Hydro Power Plant.

Unit 3: Synchronous Generator **[8 Hrs]**

3.1 Basic construction and working principle
3.2 Three phase synchronous generate and its specification

3.3 Speed of rotation and induced emf, Power and torque
3.4 Excitation system and armature reaction
3.5 Equivalent circuit of synchronous generator
3.6 Types of 3-phase synchronous generator (cylindrical rotor types and silent pole type)
3.7 Synchronizing generator in Hydro power, Parallel operation of 3-phase synchronous generator
3.8 Working principle and circuit diagram of AVR

Unit 4: Switchgear and Protection **[6 Hrs]**

4.1 Bus-bar, panel board, metering unit
4.2 Relays: over current and earth fault
4.3 CT and PT for protection and measurement
4.4 Circuit Breaker and Isolator, earthing and lightning protection
4.5 Construction and working of transformer
4.6 Types of transformer: Power transformer, distribution transformer and their components
4.7 Single line diagram of switchgear and protection system

Unit 5: Transmission Line and Distribution Line **[8 Hrs]**

5.1. To understand primary and secondary transmission, primary and secondary distribution
5.2. Feeder service main line distributor
5.3. Components of transmission and distribution system (poles, insulator, conductor-ACSR and ABC)
5.4 Transmission voltage selection, power losses

Unit 6: Penstock Joints and Valves **[6 Hrs]**

6.1 Types of joints: Flanged, Spigot and socket, expansion joints
6.2 Type of Valves, gates and their components using in Hydro power plant
6.3 Penstock supporting components
6.4 Sizing of penstock pipes
6.5 Introduction to bi-furcation and tri-furcation of penstock pipes

Unit 7: Hydro Turbine **[8 Hrs]**

7.1. Basic terminologies: head, flow rate, power, efficiency, specific speed
7.2 Classification of turbine
7.3. Working principle and components of Francis, Pelton, Cross-flow and Kaplan turbine
7.4. Selection of turbine for specific site
7.5. Application of flywheel
7.6 Stopping of turbine
7.7. Installation procedure of impulse and reaction turbine

Unit 8: Drive System **[4 Hrs]**

8.1 Coupling system with generator
8.2 Introduction of Drive system in hydro power
8.3 Types and their components
8.4 Safety guards of drive system in hydro power.

Unit 9: Governor **[4 Hrs]**

9.1 Purpose of governor
9.2 Working principle of simple mechanical governor
9.3 Working principle of oil pressure governor
9.4 Associate components of oil pressure governor and their uses

Unit 10: Repair and Maintenance of Electromechanical Components **[10 Hrs]**

10.1 Routine inspection and maintenance of hydro turbine and Auxiliaries (daily, weekly, monthly)
10.2 Annual Inspection and Maintenance
10.3 Capital Maintenance
10.4 Material handling equipment inside power house
10.5 Typical Problems in the maintenance of hydro turbines
10.6 Typical Problems in the maintenance of major electrical components
10.7 Problem identification: Corrosion, overheating of machine, high noise, over speed
10.8 Adjustment and Replacing turbine and generator
10.9 Alignment of shaft generator-turbine

Practical/Laboratory: ***[2*15=30 Hrs]***

1. Practice of Earthing process.
2. Power measurement of generator.
3. Case study on selection of turbine.
4. Practice on installation of small machine over foundation in lab
5. Performance measurement of Pelton/Francis Turbine
6. Visit for case study on the Hydro-electric power plant on operation focusing all the major components.

Tutorial: ***[2*15=30 Hrs]***

1. Generator sizing [6 Hrs]
2. Transformer sizing [6 Hrs]
3. Conductor sizing and loss calculation [6 Hrs]
4. Sizing of penstock pipes [8 Hrs]
5. Power estimation and Selection of turbine [4 Hrs]

References:

1. R.K. Bansal, "A text of Fluid Mechanics and Hydraulics Machines", Laxmi Publication (P) LTD. India.
2. Standards/manuals/ guidelines for small hydro development: Electro-mechanical works-operation and maintenance of small hydro power plant, IIT Rorkee, India.
3. Installation and commission manual for Micro Hydro power plant by ICIMOD-Kathmandu 1999
4. Micro-Hydro Design Manual: A Guide to Small-Scale water power schemes, Adam Harvey, Practical Action Publishing, 1993.
5. Guidelines Operation and Maintenance of Hydropower Plants, Substations and Transmission lines, Government of Nepal Ministry of Energy Department of Electricity Development Kathmandu, January 2017.

Marks specification for final examination

Unit	Content	Course Hours	Marks
1	Hydro-Electro-Mechanical Components	2	3
2	Choosing the Supply AC or DC System	4	5
3	Synchronous Generator	8	11
4	Switchgear and Protection	6	8
5	Transmission Line and Distribution Line	8	11
6	Penstock Joints and Valves	6	8
7	Hydro Turbine	8	11
8	Drive System	4	5
9	Governor	4	5
10	Repair and Maintenance of Electromechanical Components	10	13
	Total	**60**	**80**

Note: There might be minor deviation in marks distribution.

Major Project
EG 3204 HE

Year: III **Total: 10 Hrs/week**
Part: II **Lecture: Hrs/week**
Tutorial: Hrs/week
Practical: 10 Hrs/week
Lab: Hrs/week

Course description:

This course is designed to make students aware of using theoretical and practical application in integrated manner to their knowledge gained during whole course related to civil engineering. Topics will normally contain measurement, design, drawing, cost estimate of components of hydropower, building, water supply and sanitary, irrigation and road. Reading assignments and lecture on report design and oral presentations techniques will be in beginning of session. Preparation of the report and an oral seminar will occur at the end of the session.

Course objectives:

After completion of this course students will be able to:

1. Prepare design, drawing and cost estimate of residential/small office hydropower projects;
2. Prepare design, drawing and cost estimate of small and micro-hydropower projects.
3. Prepare design, drawing and cost estimate of a building
4. Prepare and design layout and cost estimate of Water supply and Irrigation works.
5. Prepare and design layout and cross-section and cost estimate of road

Course Contents:

Unit 1: Hydropower **[50 Hrs]**

1.1. Collection of available literatures and information about hydropower site.
1.2. Preparing a tentative layout of all civil components of hydropower based on topographical map.
1.3. Collection of all data about discharge at intake site (use any of empirical methods used in Nepal if the river is ungauged) and fix the design discharge.
1.4. Estimate power potential (not less than 500Kw) and monthly and annual energy.
1.5. Carryout sizing of each civil components and approximate sizing of electro-mechanical components.
1.6. Prepare a final layout with design of each civil components
1.7. Calculate the total cost of the project and energy cost and carry out financial analysis of the project (B/C ratio and IRR).

Unit 2 Building: **[40 Hrs]**

1.1 Measure a plot of land for building layout.
1.2 Collect materials and labour rate for rate analysis.

1.3 Carryout architectural design and drawing of a 3 or 4 rooms and 2 to 4 storey residential/office building (site plan, floor plans, elevations, sections, flooring, roofing, staircase, finishes, fire place details).
1.4 Design/interpret structural components (foundation, wall, column, beams, ties, floors, and roof trusses) including seismic details drawings.
1.5 Prepare design and drawing of internal plumbing details (bathroom, hot and cold water supply system, waste water and rain water systems).
1.6 Study drawing of electrical system (power, light layout) and telephone network system.
1.7 Rate analysis and detailed cost estimate.
1.8 Prepare drawings both manually and using CADD software.

Unit 3: Sanitary and Water Supply: [20 Hrs]

3.1. Prepare/observe external drainage system, sewer pipe layout, septic tank, soak pit design and drawings.
3.2. Prepare design and drawings of a rural water supply scheme (gravity flow).
3.3. Prepare bill of quantities and cost estimate.

Unit 4: Highway: [20 Hrs]

4.1. Study of contour map.
4.2. Draw layout of road alignment, profile, cross-section with the help of given data/topographic map.
4.3. Design horizontal and vertical curve.
4.4. Provide typical retraining structures, drains and culverts.
4.5. Prepare bill of quantities and cost estimate.

Unit 5: Irrigation: [20 Hrs]

5.1. Draw layout, profile and cross-section of small hill irrigation project with the help of given data/topographic map.
5.2. Draw typical head works structure (weir, trash-rack), aqueduct, fall, Siphon, lined canal sections etc.
5.3. Prepare bill of quantities and cost estimate.

References:

1. Course notes provided by the teachers/department.
2. Sample drawings of different municipality office, Nepal Government Projects.
3. Building bye-laws.
4. Building Construction Hand Book by Roy Chudley and Roger Greeno.
5. Nepal National Building Codes.
6. Village water systems- A technical journal (Nepal and Bhutan)
7. Estimating and Costing by B. N. Dutta.
8. Text books of related courses.
9. Government norms of rate analysis.

***Marks Specification for final examination**:*

S. No.	Subjects/Topics	Hrs	Marks distribution	Internal	Final
1	Hydropower	50	100	60	40
2	Building	40	60	36	24
3	Sanitary and Water Supply	20	30	18	12
4	Highway	20	30	18	12
5	Irrigation	20	30	18	12
Total		**150**	**250**	**150**	**100**

Note: A complete project report with presentation is conducted at the last of the semester.

Micro Hydropower (Elective)

EG 3205 HE.1

Year: III **Total: 6 Hrs/week**
Part: II **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 3 Hrs/week

Course description:

This course is aimed to provide general background knowledge of micro-hydropower projects, assessing hydro-potential, load demand and supply, its components, functions and design of main features.

Course objectives:

After completion of this course, students will be able to:

1. Understand the concept of micro-hydropower;
2. Be familiar with the its components and functions and;
3. Understand the principles of sizing and design

Course Contents:

Unit 1: Introduction **[**3 **Hrs]**

2.1 Introduction and working principle
2.2 History of MHP in Nepal
2.3 Multipurpose use of MHP
2.4 Site selection for MHP
2.5 Measurement of head- Abney level, Auto Level, GPS Device

Unit 2: Hydrology **[**6 **Hrs]**

2.1 Introduction and definitions
2.2 Guidelines and standards
2.3 Discharge measurement- Bucket method, Float Method, Salt Gulp Dilution Method, Current Meter
2.4 Hydrology and Nepali MHP
2.5 Hydrological data
2.6 Flow Estimation: Medium Irrigation Project (MIP) Method, WECS/DHM (HYDEST) Method
2.7 Flood flows and estimations

Unit 3: Head Works **[**4 **Hrs]**

3.1 Introduction and definitions
3.2 Guidelines and standards
3.3 Functions of weir, intake, track rack and spillway
3.4 Design criteria of weir and intake
3.5 Detail drawing of head works

Unit 4: Headrace and Tailrace **[**4 **Hrs]**

4.1 Introduction and definitions
4.2 Functions and components of headrace canal

4.3 Guidelines and standards
4.4 Design of canal and pipe
4.5 Detail drawings of headrace and tailrace

Unit 5: Settling Basins **[5 Hrs]**

5.1 Introduction and definitions
5.2 Functions and components of settling basins
5.3 Guidelines and Standards
5.4 Settling basin theory
5.5 Design criteria of gravel trap, settling basin and forebay
5.6 Detail drawings of settling basin

Unit 6: Support System **[4 Hrs]**

6.1 Introduction and function of support system
6.2 Design criteria of anchor block,
6.3 Design criteria of support pier
6.4 Design criteria of machine foundation

Unit 7: Penstock and Power Calculations **[4 Hrs]**

7.1 Introduction and definitions
7.2 Guidelines and standards
7.3 Detail drawings of penstock pipe and alignment

Unit 8: Turbine Selections **[4 Hrs]**

8.1 Introduction and definitions
8.2 Guidelines and standards
8.3 Turbine selection chart
8.4 Detail drawing of turbine

Unit 9: Electrical Equipment Selections **[4 Hrs]**

9.1 Introduction and definitions
9.2 Guidelines and standards
9.3 Sizing and RPM of synchronous and induction generator
9.4 Load management, ELC and its functions
9.5 Detail drawings of electrical component (single line diagram) indicating Generator, Transformer, Isolators and switches, Grounding and Earthling, Protection devices, ELC and other.

Unit 10: Transmission and Distribution **[4 Hrs]**

10.1 Introduction and definitions and components
10.2 Guidelines and standards
10.3 Design/selection criteria of transmission and distribution system: Voltage selection, Conductor selection, Poles and accessories, protection and safety
10.4 Detail drawings of transmission and distribution (single line diagram)

Unit 11: Operation and Maintenance (O&M) **[3 Hrs]**

11.1 O&M of civil structures
11.2 O&M of mechanical equipment
11.3 O&M of electrical equipment

Practical/Laboratory: ***[45 Hrs]***

Perform the design and drawing of followings:

1. Appropriate sizing of plant
2. Balancing energy demand and supply
3. Measurement of head and flow
4. Calculation of mean monthly flow and design flow
5. Sizing of orifice, spillway, headrace canal, pipes etc.
6. Desander and forebay tank
7. Sizing of turbines, generators, conductors

References:

1. Allen R. Inversin (1986), Micro-Hydropower Sourcebook, A Practical Guide to Design and Implementation in Developing Countries, NRECA International Foundation, 1800 Massachusetts Avenue N. W., Washington, DC 20036.
2. Adam Harvey (1993), Micro-Hydro Design Manual, A guide to small-scale water power schemes, Intermediate Technology Publications, ISBN 1 85339 103 4.
3. BPC Hydro consult, Intermediate Technology Development Group (ITDG), Kathmandu, Nepal (2002), Civil Works Guidelines for Micro-Hydropower in Nepal.
4. GTZ/Department of Energy Development, Energy Division, Papua New Guinea, Micro Hydropower Training Modules (1994), Modules 1-7, 10, 13, 14 & 18B.
5. European Small Hydropower Association (1998), Layman's Guidebook on How to Develop a Small Hydro Site
6. AEPC, Micro-Hydro Detail Feasibility Study Guideline
7. AEPC, Micro-Hydro Reference Standard
8. AEPC/NMHDA (2013), Micro/Mini-Hydropower Survey & Design Tools

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Introduction	3	4
2	Hydrology	6	8
3	Head Works	4	8
4	Headrace and Tailrace	4	8
5	Settling Basins	5	8
6	Support System	4	8
7	Penstock and Power Calculations	4	8
8	Turbine Selections	4	8
9	Electrical Equipment Selections	4	8
10	Transmission and Distribution	4	8
11	Operation and Maintenance (O&M)	3	4
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Hydropower Structures (Elective)

EG 3205 HE.2

Year: III **Total: 6 Hrs/week**
Part: II **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 3 Hrs/week

Course description:

This course is aimed to provide basic knowledge of hydropower structures that used in any hydropower projects.

Course objectives:

After completion of this course, the students will be able to:

1. Identify the different structures used in Hydropower projects;
2. Able to find the positioning of the structures in projects layout (drawing and ground)
3. Know the principles of sizing of different hydropower structures

Course Contents:

Unit 1: Introduction **[**2 **Hrs]**

1.1 Introduction
1.2 Layout of Hydropower Projects
1.3 Principles of Hydraulic Systems Analysis

Unit 2: Dam engineering **[**8 **Hrs]**

2.1 Introduction
2.2 Embankment dam types and characteristics
2.3 Concrete dam types and characteristics
2.4 Site assessment and selection of dam types
2.5 Loads on Dams
2.6 Basic Design of embankment and Concrete dams

Unit 3: Flow Control Structures **[**9 **Hrs]**

3.1 Classification and Use of Structures for Flow Control
3.2 Flow Regulating Structures (Weirs, Broad-crested Weirs (Free and Submerged Flow), Sharp-crested Weirs (Free and Submerged Flow), Sluice Gates, Vertical Sluice Gates (Free and Submerged Flow) Radial Sluice Gates (Free and Submerged Flow), Hydraulic Jumps
3.3 Downstream of Sluice Gates, Diversion Barrages (containing sluices and weirs in parallel)
3.4 Channel Intake and Outlet (Diversion) Structures: Gated Pipe Diversion Structure, Weirs and Sluice Gates as Diversion Structures

Unit 4: Structures in Conveyance System **[5 Hrs]**

4.1 Canal: shapes, characteristics, basic design concepts
4.2 Settling basin / De-sanding basin: design concepts
4.3 Tunnel: shapes, characteristics, / pipe: shapes, characteristics
4.4 Fore-bay / Surge tank: types, characteristics and basic design concept
4.5 Pressure pipe / penstock: characteristics and basic design concepts

Unit 5: Outlet structures at Head Work **[9 Hrs]**

1.1 Dam Spillways
1.2 Ungated and Gates spillway: Ogee Crests spillway
1.3 Gate Piers spillway
1.4 Shaft Spillways
1.5 Design principle of Spillways (Crest Elevation, Dimensions, and Shape)
1.6 Energy Dissipation Structures
1.7 Hydraulic Jumps (Sequent Depths, Length, Profile)
1.8 Stilling Basins and basic design concepts
1.9 Roller Buckets and Flip Buckets
1.10 Dam Bottom Outlet Works

Unit 6: Power House Structures **[7 Hrs]**

1.1 Principle of Power house sizing
1.2 Powerhouse for Francis Turbine
1.3 Draft Tube and its principle
1.4 Power house for Pelton Turbine
1.5 Tail water (canal / tunnel) structures
1.6 Flow control Gate valves: types and characteristics
1.7 Turbine shaft and its necessity
1.8 Governor and its necessity

Unit 7: Power Transmission from Power House **[5 Hrs]**

7.1 Introduction of Transistors and its components
7.2 Introduction of Substation and its components
7.3 Introduction of Transmission lines and its components

Practical/Laboratory: ***[45 Hrs]***

1. Prepare a report containing the detail of any hydropower plant structure as literature and give a group presentation.
2. Perform the two days' field visit to the students to make familiar with different structures followed by a group presentation and individual field report.

References:

1. S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers.
2. A. R. Inversin, "Micro-Hydropower Sourcebook: A Practical Guide to Design and Implementation in Developing Countries", ITDG Publishing
3. P. N. Modi, "Irrigation Water Resources and Water Power Engineering", Standard Book House
4. P. Novak, AIB. Moffat, C. Nalluri, C, "Hydraulic Structures", Taylor and Francis, London
5. Harvey, A., Micro-Hydro Design Manual: A Guide to Small-Scale Water Power Schemes, ISBN-13: 978-1853391033
6. BPC Hydroconsult, Civil Works Guidelines for Micro Hydropower in Nepal, Practical Action, Nepal.
7. Penche, C. and Minas, Ingeniero, Layman's Handbook on how to develop a small Hydro site, European Commission

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Introduction	2	4
2	Dam engineering	8	16
3	Flow Control Structures	9	16
4	Structures in Conveyance System	5	8
5	Outlet structures at Head Work	9	16
6	Power House Structures	7	12
7	Power Transmission from Power House	5	8
	Total	**45**	**80**

Note: There might be a minor deviation on the above-specified marks.

Energy Management (Elective)

EG 3205 HE.3

Year: III **Total: 6 Hrs/week**
Part: II **Lecture: 3 Hrs/week**
Tutorial: Hrs/week
Practical: Hrs/week
Lab: 3 Hrs/week

Course description:

The course is aimed at proving in basic knowledge of "energy system and its management issues related to it. The syllabus covers a comprehensive set of topics related to energy technology, management, environmental, economic and contemporary issues.

Course objectives:

After completion of this course, students will be able to:

4. Understand the concept of different types of energy resources;
5. Understand the concept of different types of energy technology;
6. Be familiar with the management of energy demand and supply;
7. Understand the principles of energy audit

Course contents:

Unit 1: Energy Resources **[4 Hrs]**

1.1 Perpetual, renewable and non-renewable energy resources
1.2 Conventional and non-conventional; traditional and commercial
1.3 Primary and secondary forms of energy
1.4 Global and national energy scenarios
1.5 Importance of energy resources in Nepal
1.6 Development of energy systems in Nepal

Unit 2: Renewable Energy Technology (RET) **[9 Hrs]**

2.1 Micro-hydro: Introduction, history, application, working principles
2.2 Improved water mill and its application
2.3 Solar PV: Introduction, types, application and components
2.4 Solar water pumping for rural water supply
2.5 Solar thermal: introduction, types, application
2.6 Biomass: Introduction, types, application and components
2.7 Wind, geothermal: introduction, applications

Unit 3: Non-Renewable Energy Technology **[5 Hrs]**

3.1 Coal: introduction and application
3.2 Gas: introduction and application
3.3 Oil: introduction and application
3.4 Nuclear energy: introduction and application
3.5 Environmental consequences

Unit 4: Environmental Aspects **[6 Hrs]**

4.1 Environmental pollution and health impacts from energy use
4.2 Global warming, climate change and environmental impact
4.3 Environment assessment: Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA)

Unit 5: Energy Management **[6 Hrs]**

5.1 Introduction of energy management
5.2 Principle of energy management
5.3 Energy management skill and strategy
5.4 Energy conservation and energy efficiency

Unit 6: Demand Side Management **[6 Hrs]**

6.1 Introduction
6.2 Energy saving: energy saving options, technical/economical potential
6.3 Energy efficiency: lighting, appliances, heating
6.4 Energy audit: importance, steps of energy audit, energy audit report

Unit 7: Supply Side Management **[4 Hrs]**

7.1 Introduction
7.2 Energy saving: energy saving options, technical/economical potential
7.3 Energy efficiency: generation, conversion, transmission, distribution
7.4 Concept of energy security and energy mix
7.5 Operational management

Unit 8: Energy Planning **[5 Hrs]**

8.1 Planning tools: introduction, types
8.2 Steps in energy planning and planning cycle
8.3 Decentralized energy planning
8.4 Integrated energy planning

Practical/Case studies: **[45 Hrs]**

1. Perform energy consumption and supply scenario of Nepal
2. Visit to nearest solar PV plant, micro-hydro power plant and biogas plant
3. Perform basic energy audit of a small organization/industry.

References:

1. G.D. Rai, "Non-conventional Energy Sources", Khanna Publishers, India
2. Energy Statistics, latest year, https://www.iea.org/data-and-statistics
3. Working manual on energy audit in Industries, Asian Productivity Organization, 2008
4. Energy Management and Audit, Bureau of Energy Efficiency, India
5. Prasanna Chandra, Projects: Planning, Analysis, Selection, Implementation and Review, Tata-McGraw Hill Publishing Company Limited, New Delhi
6. Different publications of AEPC, MoPE, MoF, WECS, MoFALD, ITDG, ICIMOD etc.
7. Integrated Energy planning, Vol. 1,2,3; APDC, Malaysia

Marks Specification for Final Examination:

Unit	Content	Course Hours	Marks
1	Energy Resources	4	8
2	Renewable Energy Technology (RET)	9	18
3	Non-Renewable Energy Technology	5	8
4	Environmental Aspects	6	10
5	Energy Management	6	10
6	Demand Side Management	6	10
7	Supply Side Management	4	8
8	Energy Planning	5	8
	Total	**45**	**80**

Note: There might be minor deviation on the above specified marks

Basics of Geographic Information System (GIS) (Elective)

EG 3205 HE.4

Total: 6 Hrs/week

Year: III **Lecture: 3 Hrs/week**

Part: II **Tutorial: Hrs/week**

Practical: Hrs/week

Lab: 3 Hrs/week

Course Description:

The primary objective of this course is to impart fundamental concepts of Database Management system and Geographical Information System. This course aims to introduce various applications of GIS and related technologies in Hydropower Engineering field. This course focus on practical approach in handling spatial and attribute data for spatial problem solving.

Course Objectives:

After the completion of this course, students will be able to:

- Understand concept of database management system.
- Understand the basic concept of GIS and its applications in various fields
- Operate GIS software for handling spatial and attribute data.
- Prepare data for GIS operation
- Perform basic queries in databases
- Prepare result maps

Course Contents:

Unit 1: Geographic Information System (GIS) **[3 hrs]**

1.1 Introduction
1.2 Components of GIS
1.3 Application of GIS
1.4 History
1.5 General Introduction of QGIS Interface

Unit 2: Database Management System **[8 hrs]**

2.1 Introduction to Database Management System
  2.1.1 Data, information & Knowledge
  2.1.2 Databases and databases management system (DBMS)
  2.1.3 Component of database management system
  2.1.4 Define: tables, form, Query, relationship, reports
  2.1.5 Various DBMS software's
2.2 Logical Data concept and Relationships
  2.2.1 Logical data concept: entities, data value, field/ attribute, records and relationships
  2.2.2 Types of relationships (one to one, one to many, many to many)
  2.2.3 Tables and field data types
  2.2.4 Primary key, candidate key and foreign key
2.3 Data models and DBMS applications
  2.3.1 Relational Data Model & types

2.3.2 Importance and use of Database Management System (DBMS)
2.3.3 Benefits of DBMS compared to file system

Unit: 3 Spatial Data Models **[12 hrs]**

3.1. Spatial Data Models
3.1.1 Vector Data Model
3.1.2 Define Vector Data Models
3.1.3 Define Scale
3.1.4 Various vector file formats
3.1.5 Introduce Geometry types of vector data (Point, Line & Polygon)
3.1.6 Various applications of vector data model
3.1.7 Advantages and disadvantages of vector data model
3.2 Raster data Model
3.2.1 Define Raster Data Models
3.2.2 Resolution of raster dataset
3.2.3 Make familiar with file format of Raster data
3.2.4 Introduce the raster data structure (Grid Cells): Regular and Irregular Tessellation
3.2.5 Applications of raster data models
3.2.6 Advantages and disadvantages of the use of Raster data model
3.2.7 General concept of Digital Elevation Model.
3.3 TIN Data Models
3.3.1 Define TIN data model
3.3.2 Data Structure of TIN model
3.3.3 Applications of TIN data model

Unit: 4 Spatial Data Acquisition and Preparation **[10 hrs]**

4.1 Sources of Spatial Data
4.1.1 Primary Data Sources
- Field base technique: Total Station, GPS, DGPS, Plane Table etc.
- Air-based Technique: Photogrammetry, UAV
- Space based Technique: Remote Sensing

4.1.2 Secondary Data Sources
- Existing paper maps (Base and thematic maps)
- Data available in Web (Clearinghouse and online sources)

4.2 Data Entry and Data Preparation
4.2.1 Geo-referencing and map projection (Coordinate system)
4.2.2 Process of map Digitization (manual, semi-automatic and automatic)
4.2.3 Process of inserting attribute data in digitized data
4.2.4 Create attribute data of digitized features

Unit: 5 GIS Operations and Map Composition **[12 hrs]**

5.1 Querying Databases
5.2 Define querying database
5.2.1 Understand structure of query language (SQL)
5.2.2 Define and explain The terms: attribute query, Spatial query (location based query)
5.2.3 Differentiate Spatial and database query

5.3 Overlay Operation and Geo-processing
5.3.1 Define and explain overlay operation: Clipping, Intersection, union, Merge, Dissolve
5.4 Result dissemination
5.4.1 Output map preparation
5.4.2 Map symbolization
5.4.3 Map design and map elements

Practical/Laboratory ***[45 hrs]***

Unit: 1 Database Management System **[3 hrs]**

1.1 Working with Existing databases
- Explore Existing Databases
- Understand the information stored in existing database

Unit 2: Exploring spatial data and data preparation **[10 hrs]**

2.1 Exploring Spatial Data using GIS software
- Familiarize with GIS software using existing data
- View Layer Properties
- Off/On/ remove data layers
- View and understand attribute table
- Change Symbology& Color
- Label features
- Navigate digital maps (Zoom In/Zoom out, Fixed Zoom in/ Fixed Zoom out, Panning)
- Selection and Export of spatial data
- Define data layers

2.2 Geo-referencing & Map Projection
- Geo-reference scanned maps/ images
- Define projection system (Local and Global system)
- Transform one projection to other (coordinate transformation)

Unit: 3 Creating data layers and table operation **[10 hrs]**

3.1 Creating Layer (Features)
- Explore data in software
- Create Vector layers (point, line polygon)
- Metadata view and preparation

3.2 Table Operations
- Attribute table: add remove data
- Relate and join tables
- Add/ remove fields
- Use of field calculator /Field Calculation
- Summarize Attribute table
- Calculate Geometry (Area, Length, and position)
- Export tables

3.3 Digitization
- Digitize raster map/ Satellite image

Unit: 4 Query and Overlay Operation **[10 hrs]**

4.1 Querying Databases

- Perform Attribute query
- Perform location query (spatial query)

4.2 Overlay Operation

- Perform following Overlay operation
  - Clip
  - Intersection
  - Union
  - Merge
  - Buffer / Multi ring buffer

Unit: 5 Visualization **[4 hrs]**

5.1.Map visualization process
5.2.Layout preparation (legends, heading, North arrow, scale)
5.3.Export maps indifferent formats (Pdf, Jpeg)
5.4.Print maps (page setting)

Unit 6: Application of GIS in Civil Engineering Field **[8 hrs]**

6.1.Georeferencing of Map
6.2.Catchment Delineation
6.3.Prepare Thiessen Polygon

References:

1. Ian Heywood, Sarah Cornelius, Steve Carver, "An Introduction to Geographical Information System", Pearson Education Publication: Pearson Education.
2. Rolf A. de, "Principles of Geographic Information System", (ed.) (ITC Education Text Book Series; 1)
3. B. Shrestha, B. Bajracharya, Sushil Pradhan, "GIS for Beginners", ICIMOD, Nepal.
4. Peter. A. Burrough and Rachael A., "Principles of Geographical Information System", McDonnnell.

Marks Specification for Final examination:

Unit	Content	Course Hours	Marks
1	Geographic Information System (GIS)	3	6
2	Database Management System	8	14
3	Spatial Data Models	12	20
4	Spatial Data Acquisition and Preparation	10	18
5	GIS Operations and Map Composition	12	22
	Total	**45**	**80**

Note: There might be minor deviation in marks distribution

Experts Involved in Curriculum Revision, 2022

S.N.	Name	Position	Organization
1	Dr. Krishna Prasad Shrestha	Asst. Professor	SoE, Kathmandu University
2	Dr. Ram Krishna Regmi	Lecturer	IOE, Pulchowk Campus
3	Rajendra Bahadur Chhetri	Lecturer	IOE, Pulchowk Campus
4	Raj Kumar Chaulagain	Lecturer	IOE, Thapathali Campus
5	Debendra Bahadur Raut	Lecturer	IOE, Thapathali Campus
6	Govinda Poudel	Lecturer	IOE, Thapathali Campus
7	Ramesh Karki	Lecturer	IOE, Thapathali Campus
8	Ram Prasad Neupane	Lecturer	IOE, Thapathali Campus
9	Santosh Chaudhary	Lecturer	SoE, Kathmandu University
10	Shailendra Raj Khanal	Instructor	IOE, Thapathali Campus
11	Pramod Shrestha	Instructor	IOE, Thapathali Campus
12	Sachin Bajracharya	Instructor	CTEVT, Shankharapur
13	Prajwal Narayan Shrestha	Instructor	CTEVT, Shankharapur