Fifth Semester
Subjects:

1	EG 3101 CE	Surveying III
2	EG 3102 CE	Estimating and Costing II
3	EG 3103 CE	Design of Reinforced Concrete (RC) Structures
4	EG 3104 CE	Transportation Engineering I
5	EG 3105 CE	Sanitary Engineering
6	EG 3106 CE	Construction Management
7	EG 3107CE	Design of Steel and Timber Structure

Surveying III
EG 3101 CE

Year: III **Total: 7 Hrs. /week**
Semester: I **Lecture: 3 Hrs./week**
Tutorial: Hr./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 computation, and setting out of curves, optical and electronic distance measurement.

Course Objectives
After completion of this course students will able to:
1. Apply different techniques of civil engineering survey;
2. Perform traverse survey, detailing, heightening, curves design, and layout techniques and
3. Carryout building layout techniques.

Course Content

Theory

Unit 1: Trigonometric Leveling [6 Hrs.]

1.1 Observation for heights and distances – Base of the object accessible
1.2 Observation for heights and distances – Base of the object inaccessible: instrument stations and elevated object are in the same vertical plane, instrument axes at different level
1.3 Observation for heights and distances – Base of the object inaccessible: Instrument stations and elevated object are in the same vertical plane, Instrument axes at very different level
1.4 Observation for heights and distances – Base of the object inaccessible: instrument stations and elevated object are not in the same vertical plane

Unit 2: Tachometry Surveying [8 Hrs.]

2.1 Introduction to tachometry
2.2 Instrument used in tachometry
2.3 System of tachometric measurements – Stadia system, Tangential System, and Subtense Bar System
2.4 Stadia method - Principle of Stadia method, Distance and elevation formula For horizontal line of sight and inclined line of sight with staff vertical
2.5 Determination of instrumental constants K and C
2.6 Tangential method - Distance and elevation formula for different cases: Both angles are angles of elevation, both angles are angles of depression, One angle of elevation and other angle of depression
2.7 Stadia field procedures
2.8 Errors in stadia tachometry

Unit 3: Horizontal Curve **[8 Hrs.]**

3.1 Classification of horizontal curves – Simple circular curve, Compound curve, Reverse curve, Transition curve, Combined curve
3.2 Designation of curves – Arc definition, and Chord definition
3.3 Elements of simple circular curve – Tangent length, Length of the curve, Length of long chord, Apex distance, Mid-ordinate
3.4 Setting out of simple circular curve by linear method – offsets from the long chord, perpendicular offset from tangent, Radial offset from tangent
3.5 Setting out of simple circular curve by angular method - Rankine's method of deflection angle, Two theodolite method

Unit 4: Vertical Curve **[7 Hrs.]**

4.1 Introduction to vertical curve, Gradient, Rate of change of grade, Length of vertical curves
4.2 Types of vertical curves – Summit curve, and Valley or Sag curve
4.3 Total change of grade
4.4 Computation and setting out of vertical curves - Tangent correction method, and Parabolic equation method

Unit 5: Transition Curve **[4 Hrs.]**

5.1 Introduction to transition curve
5.2 Use of transition curve
5.3 Notation and Elements of combined curve (circular and transition curve)

Unit 6: Total Station Surveying **[6 Hrs.]**

6.1 Introduction of Total station
6.2 Features of Total station
6.3 Electronic data recording
6.4 Field surveying procedure of Total station

Unit 7: Geographic Information System (GIS) **[2 Hrs.]**

7.1 Introduction of GIS
7.2 Application of GIS in civil engineering projects

Unit 8: Global Positioning System (GPS) **[2 Hrs.]**

8.1 Introduction to GPS
8.2 Components of GPS
8.3 Working principle and uses of GPS

Unit 9: Construction Surveying **[2 Hrs.]**

9.1 Four room Building layout – Linear method (3,4, 5 method) and Angular method
9.2 Setting out of a sewer line at plain and sloping ground

Practical (Field Works)

1. Perform the trigonometric leveling for determination of height and distance (base of the object accessible and inaccessible cases) [8 Hrs.]
2. Perform the tachometric surveying (Topographic map) by stadia method, and tangential method [12 Hrs.]
3. Set out simple circular curve by linear and angular method [16 Hrs.]
4. Set out simple building by linear and angular method [8 Hrs.]
5. Set out of a sewer line at plain and sloping ground [8 Hrs.]
6. Demonstrate Total Station and GPS [8 Hrs.]

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

Textbooks:

1. R Agor, "Surveying and Leveling", Khanna Publication New Delhi.
2. Dhakal B.B. and Karki B.K., "Engineering Surveying I &II", Heritage Publishers and Distributers Pvt. Ltd., Kathmandu, Nepal.

References:

1. N Basnet and M Basnet, "Basic Surveying – I & II", Benchmark Education Support Pvt. Ltd., Tinkune Kathmandu and Rajmati Press, Lalitpur.
2. S K Duggal, "Surveying" Vol I and II, Tata MC Graw Hill Publishing.
3. Dr. B. C Punmia, " Surveying " Vol I and II, Laxmi Publication New Delhi

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Title	Hrs.	Mark distribution*
1	Trigonometric Leveling	06	08
2	Tachometry Surveying	08	16
3	Horizontal Curve	08	16
4	Vertical Curve	07	12
5	Transition Curve	04	08
6	Total Station	06	08
7	Geographic Information System (GIS)	02	04
8	Global Positioning System (GPS)	02	04
9	Construction Surveying	02	04
	Total	**45**	**80**

* There may be minor deviation in marks distribution.

Estimating and Costing II
EG 3102 CE

Year: III **Total: 6 Hrs. /week**
Semester: I **Lecture: 3 Hrs./week**
Tutorial: 3 Hr./week
Practical: Hrs./week
Lab**: 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 plan and hilly area;
3. Analyze rate of road and water supply and sanitations works;
4. Provide basic knowledge of the value of existing properly and role of computes in valuation;
5. Provide basic knowledge of specifications building and road works and
6. Prepare estimate of road and restoration works.

Course Contents:

Theory

Unit 1: Introduction: [5 Hrs.]
1.1. Terms used in Earthwork in road construction- Banking, Cutting, Side slope, Longitudinal section, Cross section, Mean Height
1.2. Terms used in Sanitary and Water supply works- Septic Tank, Soak Pit, Manhole
1.3. Distribution of water supply system (gravity and non-gravity system)

Unit 2: Estimate of Road construction: [10 Hrs.]
2.1 Various methods of earthwork calculation in road work- Mid Sectional Area method, Mean Sectional Area method, Prismoidal Formula method
2.2 Earthwork calculation of road work in plain area
2.3 Earthwork calculation of road work having vertical drop
2.4 Earthwork calculation of road work in hilly area
2.5 Estimate of different items of Flexible pavement works

Unit 3: Analysis of Rates of Road, Sanitary and Water supply Works [8 Hrs.]
3.1. Task or outturn work
3.2. Factor's affecting the cost of Road, Sanitary and Water supply works
3.3. Govt. procedure of preparing rate analysis of Road, Sanitary and Water supply works

Unit 4: Property Valuation: [10 Hrs.]
4.1. Definition
4.2. Purpose of valuation
4.3. Principle of valuation

4.4. Factors affecting the valuation of property
4.5. Definition of terms used in valuation- Value and Cost, Book value, Asset value, Distress value or Forced sale value, Replacement value, Annuity, Perpetual annuity, Differed annuity, Scrap value, Salvage value, Gross income, Outgoings, Net income, Capitalized value, Year's purchase, Sinking fund, Depreciation and its types
4.6. Method of Depreciation in property valuation- Straight line method with solved example, Constant percentage method with solved examples, Declining balance method with solved examples
4.7. Preparation of sample 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. General specification for Building work - Earthwork in excavation, Plain Cement Concrete work, Steel reinforcement, formwork, brick masonry work, stone masonry work, wood work for doors and windows frame and shutters, cement sand plaster work, CGI sheet roofing
5.8. General Specifications Road works: Embankment construction, Sub-grade, Base course, WBM road, Surface dressing using hot bitumen, Premix carpet

Tutorial: [45 Hrs.]

Taking out detailed quantities and preparing estimate for the following:

1 Calculate earthwork in road construction by three methods
2 Calculate earthwork of road in plain area
3 Calculate earthwork of road having vertical drop
4 Calculate earthwork of road in hilly area
5 Estimate metaled road of one Km
6 Evaluate report of properly valuation
7 Estimate restoration work of road

References:

1 Amarjit Agrawal "civil estimating quantity surveying and valuation, " Katson publishing house, Ludhiana, 1985.
2 M. Charkraborti' estimating, costing, specifications and valuation in civil engineering"
3 G.S. Berdie "text book of estimating and costing".

Evaluation Scheme

Unit	Title	Hrs.	Mark Distribution
1	Introduction	5	8
2	Earthwork in road construction	10	20
3	Analysis of Rates (for road, sanitary and water supply works)	8	20
4	Valuation	10	16
5	Specifications	12	16
		45 Hrs.	**80**

Design of Reinforced Concrete (RC) Structures
EG 3103 CE

Year: III
Semester: I

Total: 8 Hrs. /week
Lecture: 4 Hrs./week
Tutorial: 2 Hrs./week
Practical: 2 Hrs./week
Lab: Hrs./week

Course Description:
This course provides the general ideas and design of RC members using relevant codes of practice. After completion of this course, students must be able to supervise RC constructions and he should be able to design simple 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. Hence, it mainly focuses on the design of RC members and check as per code for strength and serviceability requirements.

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. Able to design structural elements of steel beams and columns- compression and tension members, timber beams, steel and timber joints.
3. Able to design structural elements of RCC: Slabs, beams, columns, stairs by LSM.
4. Understand concept of design and codal provisions
5. 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, IS: 456-2000 & 2016, SP-34 & IS: 13920 and related codes of practice.

Course Contents:

Unit1: Design Concept of Reinforced Concrete by Working Stress Method (WSM) [10 Hrs.]

1.1 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.
1.2 Different grades of cement and steel. Properties of concrete and steel reinforcement (mild &HYSD bars), concept of characteristics strength, grades of concrete reinforcing bars.
1.3 Working Stress Method (WSM) of Design: Assumptions, merits and demerits/limitations.
1.4 Modular ratio, permissible-, ultimate stresses and factor of safety.
1.5 Stress strain diagram, actual and critical neutral axis (NA), position of NA, Lever Arm, Moment of Resistance (MR).
1.6 Under reinforced, over reinforced and balanced sections.
1.7 Behavior of RCC sections in bending
1.8 Analysis and design of singly reinforced rectangular sections.
1.9 Analysis and design of doubly reinforced rectangular sections.
1.10 Concept of shear reinforcement.

Unit 2: Design Concept of Reinforced Concrete by Limit State Method (LSM) [4 Hrs.]

2.1 Concept of different limit states and assumptions made in limit state of collapse.

2.2 Limit state of strength and serviceability. Safety and serviceability requirements/deflection control of structures as per codes.
2.3 Partial safety factor for loads, partial safety factor for materials, design strength of materials and design loads.
2.4 Stress-strain curves for concrete and steel, stress block, maximum strain in concrete, idealized stress-strain diagrams for steel and concrete.

Unit 3: Design of Reinforced Concrete beams by Limit State Method (LSM) [14 Hrs.]

3.1 Limiting values of NA for different grades of steel. Design bending moments and shear force. MR for singly and doubly reinforced rectangular sections.
3.2 Effective span for cantilever, simply supported and continuous beams, limits on area and spacing of reinforcement, side-face reinforcement as per NBC: 110 and IS 456:2000 & 2016.
3.3 Design of singly reinforced cantilever and simply supported rectangular beams. Numerical problems to evaluate moment of resistance and design related problems.
3.4 Design of doubly reinforced rectangular sections.
3.5 Behavior of T- and L-beams. Design of T- and L-beams.
3.6 Concept of continuous beams and knowledge on reinforcement placement.
3.7 Design of doglegged and open-well staircase.

Unit 4: Design Concept of Reinforced Concrete Beams on Shear by LSM [8 Hrs.]

4.1 Shear behavior and failure in shear with examples. Critical section for shear. Forms of shear reinforcement.
4.2 Design shear strength of concrete, maximum shear stress, design shear strengths of vertical/inclined stirrups/bent-up bars. Nominal shear stress.
4.3 Design of shear reinforcement in the form of vertical stirrups, inclined stirrups and bent-up bars. Minimum shear reinforcement. Simple design examples.
4.4 Bond between concrete and steel reinforcement, types of bond, bond stress, and check for bond stress.
4.5 Development length in tension and compression anchorage value of hooks, 90° bend and 45° bend, standard lapping of bars, check for development length.
4.6 Need for bar curtailment and detailing.

Unit 5: Design Concept on one-way and two-way slabs by LSM [8 Hrs.]

5.1 Introduction and classification of slabs. One-way and two-way slabs. Effective span of slab, live (imposed) loads on slabs (NBC: 103, IS: 875).
5.2 One-way slab design: Determination of slab thickness for simply supported slab to satisfy strength and stiffness requirements. Code requirement on the minimum/maximum area of reinforcement (main & secondary) and spacing of bars. Check for deflection and shear.
5.3 Introduction of cantilever and continuous slabs, design and reinforcement detailing.
5.4 Design of two-way slab: Effective span, classification of slabs as per code, bending moments (BM) coefficients for different edge conditions, design bending moments. Determine slab thickness and reinforcement bars for simply supported, restrained and continuous support condition to satisfy strength and stiffness requirements.
5.5 Edge and middle strips for different support conditions. Code requirements on the minimum/maximum area of reinforcement (main & secondary) and spacing

of bars, torsion reinforcement and curtailment of reinforcement. Check for deflection and shear.

Unit 6: Design of Columns by LSM [10 Hrs.]

6.1 Limit state of collapse in compression- assumptions.
6.2 Slenderness ratios, classification of columns, effective lengths. Minimum eccentricity for column loads.
6.3 Minimum/maximum reinforcement, number of bars in rectangular, square and circular sections, diameter and spacing of lateral ties as per NBC and IS codes.
6.4 Design of axially loaded short columns with lateral ties/helical reinforcement.
6.5 Reinforcement detailing and code requirements.
6.6 Introduction to long columns.
6.7 Column footing: Code requirements for square and rectangular footings as thickness, critical sections, minimum and maximum requirement on main and distribution reinforcement, minimum edge thickness, cover, anchorage and development lengths.
6.8 Design of isolated square and rectangular footings.

Unit 7: Introduction to Pre-Stressed Concrete: [6 Hrs.]

7.1 Concept of pre-stressing
7.2 Materials used in pre-stressed concrete and their requirements.
7.3 Methods of pre-stressing: pre-tensioning and post-tensioning
7.4 Systems of pre-stressing and post-tensioning.
7.5 Losses in pre-stress.
7.6 Merits and demerits of pre-stressing and post-tensioning.
7.7 Sagging profile of cable for post-tensioning.

Tutorial: [30 Hrs.]

1. Problems related to under reinforced, over reinforced and balanced sections in WSM.
2. Numerical problems on determining design constants, moment of resistance and area of steel for singly and doubly reinforced beams by WSM.
3. Moment of resistance and design of singly reinforced cantilever and simply supported rectangular beams by LSM.
4. Evaluation of moment of resistance and design of doubly reinforced rectangular sections by LSM.
5. Problems on design of shear reinforcement in the form of vertical stirrups, inclined stirrups and bent-up bars. Check for minimum shear reinforcement.
6. Determination of development length and check.
7. Design of one-way slabs. Check for deflection and reinforcement requirement.
8. Design of two-way slabs for different edge conditions.
9. Problems related to design of doglegged staircase.
10. Design of axially loaded short columns with lateral ties/helical reinforcement.
11. Design of square and rectangular footings.

Practical: **[30 Hrs.]**

Design and draw followings:

1. Singly reinforced rectangular beams with reinforcements detailing
2. Doubly reinforced rectangular beams
3. Singly reinforced T– beams and L-beams
4. One-way slabs (simply supported, cantilever and overhang)
5. Two-way slab with different edge conditions
6. Doglegged and open-well staircases
7. Short and long columns (axially loaded)
8. Simple pad footings for columns
9. Prepare a column-beam joint showing bars as per ductile detailing code requirement.
10. Preparation of bar bending schedule for all RC drawings
11. Introduction to structural analysis software (SAP, ETABS, STAAD Pro. etc.)

**** Note: IS: 456 is allowed in the examination***.

Text Books:

1. A. k. Jain, "Design of RC Structures",……(LSM)
2. C. M. Kale, "RCC Structures",…….. (WSM)

References:

1. S Pillai and D Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Co., New Delhi.
2. P. Dayaratnam, “Design of Reinforced Concrete Structures”, Oxford & IBH Publishing Company.
3. R Suwal, “Design of Reinforced Concrete Structures”, A.K. Book Publication, Kathmandu
4. NBC 101, 102, 103, 104, 105, 110, Nepal standards and related codes of practice.
5. IS: 456-2000 & 2016, SP-34 & IS 13920 and related codes of practice.
6. BS, EURO codes, FEMA and relevant codes.

Evaluation System

Unit	Title	Hrs.	Marks
1	Design Concept of Reinforced Concrete by Working Stress Method (WSM)	10	12
2	Design Concept of Reinforced Concrete by Limit State Method (LSM)	4	4
3	Design of Reinforced Concrete beams by Limit State Method (LSM)	14	24
4	Design Concept of Reinforced Concrete Beams on Shear by LSM	8	12
5	Design Concept on one-way and two-way slabs by LSM	8	12
6	Design of Columns by LSM	10	12
7	Introduction to Pre-Stressed Concrete:	6	4
Total		**60**	**80**

Transportation Engineering I
EG 3104 CE

Year: III **Total: 5 Hrs. /week**
Semester: I **Lecture: 3 Hrs./week**
Tutorial: 1 Hr./week
Practical: Hrs./week
Lab: 2/2 Hrs./week

Course Description:
This course is aimed to provide general background knowledge of highway engineering putting emphasis on alignment survey, geometric design, drainage, highway materials.

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 and
4. Perform different test of road construction materials.

Course Contents:

Unit 1: Introduction to Transportation System: [6 Hrs.]
- 1.1. Introduction
- 1.2. Comparison of different modes of transportation system, suitability in Nepal
- 1.3. Road transport and its advantages/disadvantages
- 1.4. History of road development
  - 1.4.1 Roman roads construction technique
  - 1.4.2 Tresaguet road construction technique
  - 1.4.3 Telford road construction technique
  - 1.4.4 Macadam road construction technique
  - 1.4.5 Comparison between Telford and Macadam
  - 1.4.6 Modern road construction
- 1.5. Road construction in Nepal
- 1.6. Road classification as per Nepal Road Standard (functional classification only), National, Feeder, District, Urban and Village road.
- 1.7. Urban road patterns
  - 1.7.1 Grid iron pattern
  - 1.7.2 Radial pattern

Unit 2: Highway Alignment and Engineering Survey: [4 Hrs.]
- 2.1. Introduction
- 2.2. Requirements of ideal highway alignment
- 2.3. Factors controlling highway alignment
- 2.4. Engineering survey for highway 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: Geometric Design of Highways: **[20 Hrs.]**

- 3.1. Introduction
- 3.2. Basic road terms
  - 3.2.1. Traffic volume (introduction only)
  - 3.2.2. Traffic capacity (introduction only)
  - 3.2.3. Skid/slip (introduction only)
- 3.3. Cross sectional elements
  - 3.3.1. Typical drawings of highway cross sections, rural roads/ urban roads
- 3.4. Camber
  - 3.4.1. Definition
  - 3.4.2. Objectives
  - 3.4.3. Types
  - 3.4.4. camber board preparation with numerical example
- 3.5. Highway curves
  - 3.5.1. Introduction, Types (Horizontal & Vertical)
  - 3.5.2. Necessity
  - 3.5.3. Design of horizontal curves (Effect of centrifugal force, transition curve with numerical examples)
- 3.6. Superelevation
  - 3.6.1. Definition
  - 3.6.2. Objectives
  - 3.6.3. Analysis of superelevation with numerical example of superelevation design in mixed traffic condition
  - 3.6.4. Methods of providing superelevation
- 3.7. Extrawidening
  - 3.7.1. Definition
  - 3.7.2. Objectives
  - 3.7.3. Analysis of mechanical widening with numerical example for calculating total widening
  - 3.7.4. Methods of providing extrawidening
- 3.8. Sight distance
  - 3.8.1. Definition
  - 3.8.2. Types
  - 3.8.3. Objectives
  - 3.8.4. Examples of situations restricting sight distance
  - 3.8.5. Numerical example of SSD & OSD
- 3.9. Gradient
  - 3.9.1. Definition
  - 3.9.2. Types (Rolling, Limiting, Exceptional, Minimum gradient)
  - 3.9.3. Factors governing the selection of grades, effect of high grades
  - 3.9.4. Grade compensation in horizontal curves (introduction only)
- 3.10. Vertical curves
  - 3.10.1. Definition
  - 3.10.2. Types (Summit & Valley)
  - 3.10.3. Design of summit curves (minimum length requirement based on stopping sight distance with numerical example)
  - 3.10.4. Design of valley curves (minimum length requirement based on both comfort and head light sight distance with numerical example)

Unit 4: Highway Drainage: **[5 Hrs.]**

4.1. Introduction and important of highway drainage
4.2. Causes of moisture variation in subgrade soil (By ground water & By free water concept only)
4.3. Requirements of good drainage system
4.4. Classification of highway drainage system
    4.4.1. Surface drainage (Types, longitudinal: lined and unlined, transverse, energy dissipating definitions), Drainage in rural highway, urban street, hill road concept, Design of surface drainage system (Numerical trapezoidal section)
    4.4.2. Subsurface drainage (Control of seepage flow, capillary rise, lowering of water table)
    4.4.3. Cross drainage (General, concept of causeways, inverted syphon, aqueduct, culverts: slab, box, arch & pipe)
    4.4.4. Energy dissipating structures: concept only.

Unit 5: Highway Materials: **[10 Hrs.]**

5.1. Classification of highway materials: Introduction, Classification based on purpose binding, mineral, other minerals.
5.2. Subgrade soil
    5.2.1. Uses
    5.2.2. Requirements of soil as a highway material
    5.2.3. California Bearing Ratio (CBR) test of soil (Test procedure)
5.3. Stone aggregates
    5.3.1. Definition
    5.3.2. Types: based on strength, grain size, shape, gradation basic concept only.
    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

Tutorials **[15 Hrs.]**

Unit 3 Geometric Design of Highways [12 H]
Unit 4 Highway Drainage: [3H]

Practical (laboratory) **[15 Hrs.]**

1. Perform California bearing test of soil
2. Perform Los Angeles 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.

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.

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Title	Hrs. (L+T)	Marks distribution
1	Introduction to Transportation System	6	12
2	Highway Alignment and Engineering Survey	4	16
3	Geometric Design of Highways	20+12	36
4	Highway Drainage	5+3	16
5	Highway Materials	10	16
	Total	**60**	**96**

Note:

Attempt any five questions out of six. All questions have (a) and (b) sub- questions.

Sanitary Engineering
EG 3105 CE

Year: III **Total: 4 Hrs. /week**
Semester: I **Lecture: 3 Hrs./week**
Tutorial: 1 Hr./week
Practical: Hrs./week
Lab: Hrs./week

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

1. Introduce sanitation and health, main diseases transmitted due to unsanitary excreta disposal;
2. Explain the process of wastewater collection, conveyance, treatment and disposal methods and design of sewers;
3. Be familiar/Familiarize 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:

Unit 1: Sanitation and health **[6 Hrs.]**

- 1.1. Introduction
- 1.2. Main diseases transmitted by unsanitary excreta disposal
- 1.3. Transmission routes
- 1.4. Preventive measures
- 1.5. Importance of sanitation, awareness of public health engineering
- 1.6. Definitions of common terms used in sanitary engineering
  - 1.6.1. Sewage/wastewater, domestic sewage, industrial sewage, sanitary sewage, storm water
  - 1.6.2. Sullage, sewer, sewerage, rubbish, garbage, refuse and solid waste
- 1.7. System of sanitation
  - 1.7.1. Conservancy system with merits and demerits
  - 1.7.2. Water carriage system with merits and demerits
- 1.8. Sewerage systems and types
  - 1.8.1. Separate system
  - 1.8.2. Combined system
  - 1.8.3. Partially separate system
  - 1.8.4. Comparison in tabular form between separate and combined systems

Unit 2: Quantity of Sewage: **[4 Hrs.]**

- 2.1. Sources of sanitary sewage
- 2.2. Dry Weather Flow (DWF) and Wet Weather Flow (WWF)
- 2.3. Factors affecting quantity of sanitary sewage
  - 2.3.1 Population
  - 2.3.2 Rate of water supply

2.3.3 Groundwater infiltration
2.3.4 Unauthorized connections

2.4. Determination of quantity of sanitary sewage -, peak factor, peak flow, minimum and maximum flows
2.5. Determination of quantity of storm water- Rational method and its limitation, Overall runoff coefficient, intensity of rainfall, Time of concentration
2.6. Numerical on determination of quantity of wastewater for separate, combined and partially separate systems

Unit 3: Design and Construction of Sewers: [4 Hrs.]

3.1. Shapes of sewer-Circular and non-circular sections with merits and merits
3.2. Sewer Materials
3.2.1. Requirement of sewer materials
3.2.2 Types of sewer materials - salt glazed stoneware, cement concrete, cast iron
3.3. Design criteria of sewers - design period, minimum and maximum velocities, self-cleansing velocity, sewer size range, sewer gradient
3.4. Hydraulic formulae for design Manning's, Chezy's and Hazen Williams formulae, hydraulic elements of circular sewers for partial flow condition, partial flow diagrams
3.5. Numerical on design of circular and rectangular sewers

Unit 4: Sewer Appurtenances (only introduction): [4 Hrs.]

4.1. Necessity of sewer appurtenances
4.2. Construction of sewer appurtenances- (location, function and construction)
4.2.1. Manhole
4.2.2. Drop manhole
4.2.3. Street inlets
4.2.4. Catch basin
4.2.5. Flushing device
4.2.6. Inverted siphon
4.2.7. Ventilating shaft
4.2.8. Water closet
4.2.9. Trap
4.2.10. Sand, grease and oil traps

Unit 5:Sampling and Characteristics of Wastewater (introduction only): [3 Hrs.]

5.1. Sampling of wastewater - grab and composite samples
5.2. Biochemical Oxygen Demand (BOD)
5.3. Chemical Oxygen Demand (COD
5.4. Decomposition of wastewater-process, aerobic and anaerobic decomposition, reactions
5.5. Wastewater disposal Standards

Unit 6: Wastewater Disposal: [5 Hrs.]

6.1. Necessity and objectives of wastewater disposal
6.2. Wastewater disposal by Dilution process and essential conditions for dilution
6.3. Self-purification of rivers/streams and sag curve
6.4. Factors affecting self-purification - Dilution, Current, Sunlight, Sedimentation, Temperature, Oxidation, Reduction

6.5. Wastewater disposal by land treatment and Suitability of land treatment
6.6. Methods of land treatment - irrigation, overland flow and rapid infiltration, Broad irrigation and sewage farming, Methods of application of sewage on land - flooding, surface irrigation, ridge and furrow method, subsurface irrigation and spray irrigation
6.7. Sewage sickness and its prevention

Unit 7: Wastewater Treatments: [9 Hrs.]

7.1. Objectives
7.2. Treatment process types and impurity removal
7.3. Primary treatment process
  7.3.1. Racks and Screens - purpose and types, design criteria, construction, working and maintenances
  7.3.2. Skimming tank – purpose and types, design criteria, construction, working and maintenances
  7.3.3. Grit chamber - purpose and types, design criteria, construction, working and maintenances
7.4. Waste stabilization pond - purpose and types, design criteria, construction, working and maintenances
7.5. Constructed wetland - purpose and types, design criteria, construction, working and maintenances
7.6. Numerical on design of Racks and Screens, Skimming tank, Grit chamber, Waste stabilization pond and Constructed wetland

Unit 8: On site Sanitations for Isolated / Unsewered Area: [8 Hrs.]

8.1. Necessity
8.2. On site sanitation - Definition and types
8.3. Pit privy - purpose and construction
8.4. Ventilated Improved Pit (VIP) latrine - purpose, construction, design criteria (single pit only)
8.5. Compost latrine- purpose and types, design criteria, construction, working and maintenances
8.6. Septic tank - purpose, construction, design criteria, working and maintenance
8.7. Disposal of septic tank effluent methods
8.8. Drain field - purpose, construction and design criteria
8.9. Soak pit - purpose, construction and design criteria
8.10. Leaching cesspool - purpose
8.11. Numerical on design of VIP latrine, Septic tank and Soak pit

Unit 9: Solid Waste Disposal: [2 Hrs.]

9.1. Characteristics of solid waste
9.2. Quantity of solid waste
9.3. Collection and transportation of solid waste
9.4. Methods of solid waste disposal
  9.3.1. Dumping
  9.3.2. Sanitary landfill
  9.3.3. Incineration
  9.3.4. Composting

Tutorials:

1. **Introduction** **[1 Hr.]**
   Definitions
2. **Quantity of Wastewater** **[2 Hrs.]**
   Definitions, Numerical on determination of sanitary sewage and storm water, determination on quantity of wastewater for separate, combined and partially separate systems
3. **Design and Construction of Sewers** **[2 Hrs.]**
   Design criteria of sewers, partial flow conditions in sewers, Numerical on design of circular and rectangular sewers for separate and combined systems
4. **Sewer Appurtenances** **[2 Hrs.]**
   Definitions and sketches
5. **Sampling and Characteristics of Wastewater** **[1 Hr.]**
   Definitions, standards
6. **Wastewater Disposal** **[1 Hr.]**
   Definitions, drawing sag curve
7. **Wastewater Treatment** **[2 Hrs.]**
   Numerical on design of Racks and Screens, Skimming tank, Grit chamber, Waste stabilization pond and Constructed wetland
8. **Disposal of Sewage from Isolated Buildings** **[3 Hrs.]**
   Definitions, Numerical on design of VIP latrine, Pour flush latrine, Septic tank and Soak pit
9. **Solid Waste Disposal** **[1 Hr.]**
   Definitions, purpose, classification

References:

1. B. C. Punmia and Ashok Jain, "Wastewater Engineering", Laxmi Publications (P) Ltd., New Delhi
2. P.N. Modi, "Sewage Treatment & Disposal and Wastewater Engineering", Standard Book House, Delhi.
3. G.S. Birdie and J, S, Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd., New Delhi
4. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd., New Delhi.

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Unit	Title	Hrs. (L+T)	Marks distribution
1	Introduction	6+1=7	8
2	Quantity of Wastewater	4+2=6	8
3	Design and Construction of Sewers	4+2=6	8
4	Sewer Appurtenances	4+2=6	8
5	Sampling and Characteristics of Wastewater	3+1=4	4
6	Wastewater Disposal	5+1=6	8
7	Wastewater Treatment	9+2=11	16
8	Disposal of Sewage from Isolated Buildings	8+3=11	16
9	Solid Waste Disposal	2+1=3	4
	Total	**60**	**80**

*There may be minor variation in marks distribution.

The questions setting should be in the multiplication of 4

Construction Management
EG 3106 CE

Year: III
Semester: I

Total: 6 Hrs./week
Lecture: 5 Hrs./week
Tutorial: 1 Hr./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, accounts, procurement of works, contract management, planning, scheduling, monitoring and control, and managing construction works.

Course Objectives

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

1. Familiarize the need of organization, and account;
2. Describe construction management;
3. Plan and schedule different activities of construction project;
4. Familiarize with monitoring and control, labor relations, and safety in construction works;
5. Familiarize with the procurement of works and contract administration; and
6. Plan and schedule resources required in construction project.

Course Content

Unit 1: Organization and Management [8 Hrs.]

1.1 Definition and need of organization
1.2 Types of organization - Line organization, Line and staff organization, and Matrix organization.
1.3 Definition and importance of Management
1.4 Principles of Management
1.5 Human Resource Management
1.6 Motivation
1.7 Definition and Need of Construction Management

Unit 2: Bookkeeping and Account [6 Hrs.]

2.1 Definition of Bookkeeping
2.2 Need and Importance of Accounting
2.3 Principle of Double Entry - Personnel account, Property or Real account, and Nominal account
2.4 Introduction to Journal, Ledger and Final account

Unit 3: Project Planning and Scheduling [12 Hrs.]

3.1 Definition and Characteristics of Project
3.2 Definition and Steps of Planning
3.3 Importance of Planning
3.4 Construction Site Planning
3.5 Work Breakdown Structure

3.6 Bar Chart with advantages and disadvantages, Linked Bar Chart, and Milestone Bar Chart
3.7 Definition of Scheduling, Preparation of Construction Schedule and its advantages
3.8 Preparation of Schedule of Resources (Material/Labor/Equipment and Finance)

Unit 4: CPM and PERT [14 Hrs.]

4.1. Introduction to CPM
4.2. Elements of Network
4.3. Network Rules
4.4. Definition of the Terms: Network Diagram, Activity, Event, Forward Pass, Backward Pass, and Critical Path.
4.5. Introduction to activity on arrow (A-O-A) method with one example.
4.6. Computation of four schedule dates, four floats, critical path, and determination of project duration using (A-O-N) method.
4.7. Introduction to PERT with one example.

Unit 5: Contract Administration [14 Hrs.]

5.1 Definition of Contract, and Definition of Contract Administration
5.2 Essentials elements of a Valid Contract
5.3 Types of Contract: Unit Price Contract/Lump Sum Contract/Cost Plus Contract
5.4 Definition of Tender Notice, and Information to be given in Tender Notice
5.5 Difference between Tender Document and Contract Document
5.6 Bid Bond and Performance Bond
5.7 Conditions of Contract
5.8 Supervision of work undertaken by a Contractor
5.9 Duties and Responsibilities of a Site Supervisor
5.10 Site Order Book
5.11 Materials at Site Account
5.12 Muster Roll
5.13 Measurement Book
5.14 Running Bill and Final Bill
5.15 Completion Report
5.16 Relation between Owner, Consultant, and Contractor

Unit 6: Monitoring and Quality Control [7 Hrs.]

6.1 Introduction to Monitoring
6.2 Purpose of Monitoring
6.3 Definition of Quality
6.4 Characteristics of Quality
6.5 Elements of Control: Quality control/Cost control/Schedule control
6.6 Stages of Quality Control

Unit 7: Construction Equipment [8 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

Unit 8: Safety and Labor Relation [6 Hrs.]

8.1 Introduction to Accidents

8.2 Causes of Accidents
8.3 Importance of Safety
8.4 Safety Measures
8.5 Meaning and Purpose of Labor Union
8.6 Labor Act 2074

Tutorial Works

Bookkeeping and Account [05 Hrs.]
CPM and PERT [10 Hrs.]

References:

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

Evaluation Scheme

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Title	Hrs.	Mark distribution*
1	Organization and Management	08	08
2	Bookkeeping and Account	06	08
3	Project Planning and Scheduling	12	12
4	CPM and PERT	14	16
5	Contract Administration	14	12
6	Monitoring and Quality Control	07	08
7	Construction Equipment	08	08
8	Safety and Labor Relation	06	08
	Total	**75**	**80**

* There may be minor deviation in marks distribution.

Design of Steel and Timber Structures
EG 3107 CE

Year: III
Semester: I

Total: 4 Hrs. /week
Lecture: 2 Hrs./week
Tutorial: 1 Hrs./week
Practical: 1 Hrs./week
Lab: Hrs./week

Course Description:
This course provides the general ideas and design of steel and timber structural members using relevant codes of practice. After completion of this course, students must be able to supervise steel fabrication and construction and he should be able to design simple steel and timber members and joints. Hence, it mainly focuses on the design of tension, compression, flexural members for axial, bending moment, shear and check as per code for strength and serviceability requirements.

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

6. Identify and select proper materials, calculate the design values for materials.
7. Able to design structural elements of steel beams and columns- compression and tension members, timber beams, steel and timber joints.
8. Understand concept of design and code provisions
9. Able to prepare the proper detailing of structural members (steel & timber) and their connections using NBC 101, 102 103, 104, 105, 111, 112; IS: 800 and related codes of practice.

Course Contents:

Theory

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

1.1 Types of rolled steel sections used in steel structures.
1.2 Grades of steel and characteristics strength; advantages and disadvantages of steel structures; use of steel table and relevant NBC: & IS: 800 codes
1.3 Types of loads on steel structure and its code specification. Codes of practice for design of steel structures
1.4 Methods of analysis and design

Unit 2: Working Stress Design Method (WSM) **[3 Hrs.]**

2.1 Basic assumptions in working stress design
2.2 Service load and permissible stresses
2.3 Design for tension, compression and bending

Unit 3:Limit State Design Method (LSM) **[1 Hrs.]**

3.1 Different limit states for steel design
3.2 Design strength of materials and design loads
3.3 Limit state of strength and serviceability

Unit 4: Joints in the Steel Structures: **[4 Hrs.]**

4.1 Types of joints: Rived, bolted and welded joints
4.2 Limit state of failure of failure of riveted and bolted joints
4.3 Rivets value and efficiency of joints

4.4 Design of simple riveted bolted joints under axial loads
4.5 Design of simple welded connections under axial loads

Unit 5: Design of Tension Members: [4 Hrs.]

5.1 Introduction
5.2 Types of tension members
5.3 Net sectional area of tension members
5.4 Design of members subjected to axial load: Simple and built-up beams
5.5 Introduction to tension splices and lug angles

Unit 6: Axially loaded Compression Members-Tubular and angle section: [4 Hrs.]

6.1 Introduction and Types of compression members
6.2 End condition, Effective lengths and their buckling behavior
6.3 Radius of gyration and slenderness ratio
6.4 Strength of compression members
6.5 Design of compressive members: Simple and built-up sections

Unit 7: Design of Flexural Members: [2 Hrs.]

7.1 Introduction and Types of flexural members
7.2 Design of simple I-beams

Unit 8: Design of Roof Trusses: [2 Hrs.]

8.1 Types of roof trusses and their components
8.2 Different types of loads on roof truss
8.3 Introduction to the design of roof trusses
8.4 Tubular sections

Unit 9: Timber Structures: [2 Hrs.]

9.1 Introduction of timber
9.2 Properties of timber
9.3 Use of timber as a structural member in construction, timber structures and factors affecting strength of timber
9.4 Code of practice (IS: 883) for design of timber structures; strength of timber
9.5 Advantage & disadvantage of timber structure

Unit 10: Design of Timber Structure: [6 Hrs.]

10.1 Design of compression members
10.2 Design of solid rectangular beam
10.3 Check for deflections
10.4 Types of joints and their connection

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

Tutorials [15 Hrs.]

1. Design of tension, compression, bending and shear members using WSM
2. Determination of rivets value and efficiency of joints.
3. Design of simple riveted bolted joints under axial loads with joint details
4. Design of simple welded connections under axial loads with joint details
5. Determination of net sectional area of tension members and their capacity.

6. Design of members subjected to axial load: Simple and built-up sections and lateral bracings.
7. Design of simple beams and simple built-up beams.
8. Introduction to different components of plate girders.
9. Design of simple steel roof trusses using rolled steel sections.
10. Design of simple compression timber members.
11. Design of simple flexural timber members.

Practical **[15 Hrs.]**

Design and draw followings:

1. Details bolted and riveted joints.
2. Details of welded joints.
3. Steel beam-column connection and column bases.
4. Steel roof truss joint details with riveted, bolted and welded connections.
5. Timber roof truss joint details using steel plates with bolted connections.
6. Common joints in different timber members of heritage structures.
7. Timber beam and column joint details.

References:

1. S Negi, "Design of Steel & Timber Structures", Tata McGraw Hill Publishing Co., New Delhi.
2. Dr. NR Chandak, "Design of Steel Structures", SK Kataria and Sons, New Delhi.
3. R Suwal, "Design of Steel and Timber Structures", R & R Group, Kathmandu
4. NBC 101, 102, 103, 104, 105, 111, 112, 113, other related codes and Nepal standards.
5. IS: 875 & 800 and related codes of practice.
6. BS, EURO codes, FEMA and relevant codes.

Evaluation System

Unit	Title	Hrs.	Marks
1	Introduction	2	6
2	Working Stress Design Method (WSM)	3	
3	Limit State Design Method (LSM)	1	6
4	Joints in the Steel Structures:	4	
5	Design of Tension Members:	4	8
6	Axially loaded Compression Members-Tubular and angle section	4	
7	Design of Flexural Members	2	8
8	Design of Roof Trusses	4	
9	Timber Structures	2	12
10	Design of Timber Structure	4	
Total		**30**	**40**