B.E. DEGREE
IN
CIVIL ENGINEERING

Year : IV

Part : I

Teaching Schedule							Examination Scheme							
							Theory			Practical				
								Final			Final			
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Duaration hours	Marks	Assesment Marks	Duaration hours	Marks	Total	Remark
1	CE 701	Project Engineering	3	1		4	20	3	80				100	
2	CE 702	Design of RCC Structure	3	2	2	7	20	3	80	25			125	
3	CE 703	Transportation Engineering II	3	1	1	5	20	3	80	25			125	
4	CE 704	Hydropower Engineering	3	2	1	6	20	3	80	25			125	
5	CE 705	Estimating & Costing	3	1		4	20	3	80				100	
6	CE 725	Elective I	3	1	1.5	5.5	20	3	80	25			125	
7	CE 707	Project I			3	3				50			50	
		Total	**18**	**8**	**8.5**	**34.5**	**120**	**18**	**480**	**150**			**750**	

PROJECT ENGINEERING
CE 701

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : I

Course Objective:

- To introduce the basic knowledge on project and project environment
- To make the students able to prepare feasibility study report and project proposal.
- To provide the sound knowledge of project planning, implementation and controlling.
- To provide knowledge on risk associated with the project
- To provide the knowledge of project finance and
- To provide the concept of modern trends and techniques of project management.

Course Outlines:

1. Introduction of Project and Project Management (6 hours)

1.1 Definition of Project, its characteristics, and example of project.
1.2 Classification of Project
1.3 Project Objective and Goal
1.4 Project Life Cycle Phases
1.5 Project Environment
1.6 Introduction to Project Management

2. Project Appraisal and Project Formulation (8 hours)

2.1 Concept of Project Appraisal
2.2 Project Proposal (technical and financial)
2.3 Procedure for Developing Project Proposal
2.4 Techniques of Project Formulation
- Feasibility analysis
- Cost Benefit analysis
- Input analysis
- Environmental analysis

3. Project Planning and Scheduling (12 hours)

3.1 Concept of Project Planning and its Importance
3.2 Project Planning Process
3.3 Work Breakdown Structure (WBS)
3.4 Project Scheduling with Bar Chart, CPM & PERT

3.5 Project Scheduling with Limited Resources (Resource Leveling and Smoothing)
3.6 Introduction to Planning Software - MS Project

4. Project Implementation and Controlling. **(7 hours)**

4.1 Introduction to Monitoring, Evaluation and Controlling
4.2 Project Control
4.3 Project Control Cycle
4.4 Elements of Project Control (time, cost and quality)
4.5 Project Schedule Control
4.6 Project Cost Control: Methods and procedure (Earned value analysis)
4.7 Project Quality Control
4.8 Introduction to Project Management Information System (PMIS)

5. Project Risk Analysis and Management **(7 hours)**

5.1 Introduction to Project Risk
5.2 Types of Project Risk
5.3 Analysis of Major Sources of Risk
5.4 Effective Management of Project Risk
- Risk Management planning
- Risk Identification
- Qualitative and Quantitative Risk Analysis
- Risk Response Planning
- Risk Monitoring and Controlling

6. Introduction to Project Financing **(5 hours)**

6.1 Project finance
6.2 Capital Structure Planning
6.3 Capital Budgeting Decision

Tutorial:

1. Writing project Proposal (2 hours)
2. Scheduling Using Bar chart & CPM (4 hours)
3. Scheduling Using Planning Software (4 hours)
4. Project Control Method (EVA) (1 hour)
5. Capital Structure Planning Exercise (2 hours)
6. Capital Budgeting Exercise (2 hours)

References:

1. IshwarAdhikari and Santosh Kr. Shrestha, "A text book of Project Engineering", Chandeshwori Publication, First Editn.
2. DhurbaP.Rizal, "Project Management" , Ratnapustakbhandar.

3. E.R. Yescombe, "Principles of Project Finance" Yescombe-Consulting Limited.
4. K. Nagarajan, "Project Management", ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India.
5. Dr. Govinda Ram Agrawal, "Project Management in Nepal" Edition: 2006, M.K. Publishers and Distributors, Kathmandu, Nepal.

DESIGN OF REINFORCED CONCRETE STRUCTURES
CE 702

Lecture : 4 **Year : IV**
Tutorial : 2 **Part : I**
Practical : 2

Course Objective:

To provide knowledge and skill to students for the design of different elements of a building structure using reinforced concrete with emphasis on Limit State Methods of Design and using code of practice

1. Concrete Structures and Design Methods (3 hours)

1.1 Introduction to Reinforced Concrete Structures
1.2 Design methods of Reinforced Concrete Structures
1.3 Characteristic strengths and loads
1.4 Design process and basis for design

2. Working Stress Method of Design (4 hours)

2.1 Basic assumption in working stress design
2.2 Working load and permissible stresses in concrete and steel
2.3 Behavior of beam under loading
2.4 Types of reinforced concrete beam and different RC sections
2.5 Design of singly reinforced rectangular beam

3. Limit State Method of design (5hours)

3.1 Safety and serviceability requirements and different limit states of structure
3.2 Design strength of materials and design loads
3.3 Idealized stress-strain diagram of concrete and steel
3.4 Limit state of collapse in flexure, shear, torsion and compression
3.5 Limit state of serviceability in deflection and in cracking

4. Design of beams: Behavior in Flexure (6hours)

4.1 Flexural behavior of reinforced concrete
4.2 Design of Rectangular beams
4.3 Design of flanged beam sections

5. Design for Shear and Torsion (4hours)

5.1 Shear stress in beams
5.2 Behavior of concrete under shear
5.3 Behavior and design strength in Torsion

6. Design for bond and development length (2hours)

6.1 Development length
6.2 Anchorage bond

6.3 Flexural bond

7. Reinforcement detailing: Codal Provisions (4hours)

7.1 Requirements for good detailing
7.2 Nominal cover
7.3 Curtailment of Flexural Reinforcement
7.4 Shear reinforcement
7.5 Splicing of reinforcement
7.6 Anchorage
7.7 Bar bending schedule

8. Limit States of Serviceability: Deflection and Cracking (6hours)

8.1 Elastic theory: Cracked, uncracked and partially cracked sections
8.2 Short-term and long-term deflections
8.3 Control of deflection in design
8.4 Control of cracking in design

9. Design of slabs and staircase (6hours)

9.1 Design of one-way and two-way slabs
9.2 Detailing of one-way and two-way slabs
9.3 Design and detailing of longitudinally loaded stairs

10. Design of compression members: Columns (8hours)

10.1 Effective length of columns
10.2 Design of short columns
10.3 Design of long columns
10.4 Reinforcement detailing

11. Design of Footings (6hours)

11.1 Design of spread footing
11.2 Design of isolated footings
11.3 Design of combined footings
11.4 Design of mat foundation

12. Introduction to Earthquake Resistant Design and Provisions for Ductile Detailing (6hours)

12.1 Damage to RCC structures in earthquake
12.2 Philosophy of design of structures in earthquake prone region
12.3 Design for strength and ductility
12.4 Provision of ductility in building codes
12.5 Ductility requirement for beam, column and joints

Tutorial:

1. Design and detailing of rectangular and flanged beams
   1.1. Flexure (4 hours)
   1.2. Shear/ Torsion (4 hours)

1.3. Bending (2 hours)
1.4. Serviceability (4 hours)
2. Design and detailing of slabs and staircase (4 hours)
3. Design and detailing of columns (4 hours)
4. Design and detailing of footings (4 hours)
5. Ductile Detailing (4 hours)

Project work:

Individual project to and design elements of a low rise building

Practical:

1. Test a beam in pure bending failure
2. Test a beam in pure shear failure
3. Test a beam in combined bending shear failure
4. Practical work on making skeleton of beam-column connection
5. Practical work on making skeleton of beam-slab

References:

1. Jain, A.K. , "Reinforced Concrete Limit State Design", Nem Chand and Bros, Roorkee, India.
2. Pillai, S.U., Menon, D. , "Reinforced Concrete Design", Tata McGraw Hill Education Private Limited, New Delhi
3. Kong, F.K., Evans, R.H. , "Reinforced and Pre-stressed Concrete", ELBS, London
4. Agrawal, P., Shrikhande, M. , " Earthquake Resistant Design of Structures", PHI Learning Private Limited, New Delhi.
5. Dayaratnam, P., "Design of Reinforced Concrete Structures", Oxford and IBH Publishing Company

TRANSPORTATION ENGINEERING II
CE 703

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 2/2

Course Objective:

To provide concept and knowledge on design, construction, repair and maintenance the roads; to be familiar with the traffic design, control and operation; and provide the glimpses on the bridge and tunnel as well

1. Traffic Engineering **(16 hours)**

1.1 Introduction and Scope of Traffic Engineering
- 1.1.1 Definition of Traffic Engineering
- 1.1.2 Scope of Traffic Engineering
- 1.1.3 Traffic Characteristics

1.2 Traffic Studies
- 1.2.1 Traffic Volume Studies
- 1.2.2 Speed Studies
- 1.2.3 Origin and Destination Studies
- 1.2.4 Traffic Flow Characteristics
- 1.2.5 Traffic Capacity Studies
- 1.2.6 Parking Studies
- 1.2.7 Accident Studies

1.3 Traffic Control Devices
- 1.3.1 Traffic Signs
- 1.3.2 Traffic Signals
- 1.3.3 Road Markings
- 1.3.4 Traffic Island

1.4 Road Intersections
- 1.4.1 Basic Requirements of Intersection
- 1.4.2 Types of Intersections and their Configuration
- 1.4.3 Channelized and Unchannelized Intersections
- 1.4.4 Rotary Intersection
- 1.4.5 Grade Separated Intersections

1.5 Road Lighting
- 1.5.1 Importance of Road Lighting
- 1.5.2 Factors Influencing Night Visibility
- 1.5.3 Requirements of Level of Illumination in Roads
- 1.5.4 Design of the Lighting System: Selection of Height of Lamps, Spacing between Light Poles,Height and Overhang of Light Poles, Lateral Placement and Lighting Layouts

2. Highway Pavement **(10 hours)**

2.1 Definition and Types of Pavements

2.2 Differences between Flexible and Rigid Pavement Structure
2.3 Loads and Other Factors Controlling Pavement Design
2.4 Design Methods for Flexible Pavements- Rode notes 29, 31, CBR, AASTHO.
2.5 Details of Asphalt Institute Method of Design of Flexible Pavements
2.6 Design Methods for Rigid Pavements and Westerguard's Theory
2.7 Stress due to Load, Temperature Differential and Sub-grade Friction
2.8 Details of the IRC Method of Design of Rigid Pavements for Highways

3. Road Construction Technology (8 hours)

3.1 Activities and Techniques Used in Road Construction
3.2 Tools, Equipment and Plants Used in Road Construction
3.3 Execution of Earth Work
3.4 Construction of Low Cost Roads
3.5 Construction of Prime Coat, Tack Coat and Seal Coat
3.6 Construction of Surface Dressing
3.7 Construction of otta-seal.
3.8 Construction of Grouted or Penetration Macadam
3.9 Construction of Different types of Bituminous Premixes
3.10 Construction of Cement Concrete Pavements

4. Highway Maintenance, Repair, and Rehabilitation (6 hours)

4.1 Classification of Maintenance Activities for Road Pavements and Road Facilities
4.2 Inspection, Prioritization and Planning of Maintenance Operations
4.3 Evaluation of Pavement Distress and Pavement Condition
4.4 Types of Road Failure and its causes
4.5 Types and Methods of Pavement Repairs
4.6 Types of Overlays and Strengthening of Existing Pavements

5. Introduction to Bridge and Tunnel Engineering (5 hours)

5.1 Choice of Bridge Location Site
5.2 Classification of Bridges and Component Parts of a Bridge
5.3 Introduction to River Bank and Protection Structure
5.4 Types of Road and Railway Tunnels
5.5 Component Parts of Tunnel and Tunnel Cross-Section
5.6 Survey for Tunnel Alignment
5.7 Drainage, Lighting and Ventilation Requirements for Tunnel
5.8 Introduction of Tunneling in Firm Soil, Soft Soil and Rock
5.9 Tunnel Lining

Tutorial:

Class room exercise on traffic volume, capacity and characteristics studies, assignment on road intersection and lighting system with report preparation. Exercise on road pavement design

Practical:

1. Determination of CBR Value
2. Measurement of Spot Speed and Data Analysis
3. Measurement of Deflection of Pavement Surface

References:

1. S.B.Sehgal and K.I. Bhanot, "A Text-book on Highway Engineering and Airports", S. Chand and Co. Publishers Ltd., New Delhi
2. S.K. Sharma, "Principles, Practice and Design of Highway Engineering", S. Chand and Co. Publishers Ltd., New Delhi
3. Dr. S.K. Khanna and Dr. C.E.G.Justo, "Highway Engineering" Nem Chand & Bros Roorkee (U.P.)
4. C.A. Flaherty, "Highway Engineering", Edward Arnold (Publishers) Ltd.
5. P.M. Parajuli, "Course Manual on Transportation Engineering" Department of Civil Engineering, Pulchowk Campus

HYDROPOWER ENGINEERING
CE 704

Lecture : 4 **Year : IV**
Tutorial : 2 **Part : I**
Practical : 2/2

Course Objectives:

To make student acquainted with the hydropower development issues starting from the inception stage to the final design stage so that students will be able to design independently various components of hydropower system.

1. Introduction **(4 hours)**

1.1 Historical Background of Power development in Nepal
1.2 Power Potential in Nepal and World, Gross, technical and economic potentials
1.3 Hydropower Development Policy of Nepal

2. Planning of Hydropower Projects **(6 hours)**

2.1 Types of Hydropower plants based on head, storage capacity and layout
2.2 Stages of hydropower development: Reconnaissance, Pre-feasibility, Feasibility studies and detailed Engineering design
2.3 Layout of run-of-river and storage hydropower Projects, Components of Run-of River, Peaking Run-of River and Storage type projects.

3. Power and Energy Potential study **(6 hours)**

3.1 Processing of hydrological data, Use of extreme and long term hydrological data, mass and elevation volume curves, flow duration curves
3.2 Gross and net head and estimation
3.3 Reservoirs and their regulation, need for flow regulation, Source of sediment, sediment yield in Rivers, sediment handing in reservoirs, life of the reservoirs
3.4 Methods of fixing installed capacity of a hydropower plant
3.5 Estimation of Power and energy potential
3.6 Mean and peak load, load curve, load factor, utilization and diversity factors

4. Headworks of Storage Plants **(18 hours)**

4.1 General Arrangement of components in a typical storage power plant: Spillways, bottom outlets or undersluices, intakes with examples.
4.2 Dam Engineering
  4.2.1 Classification based on materials, function and head
  4.2.2 Principal variants of concrete and embankment dams
  4.2.3 Dam site evaluation and selection of type of dam
  4.2.4 Loads on dams and their combinations

4.2.5 Failure modes of concrete and embankment dams and their remedies
4.2.6 Gravity (concrete) dam analysis, stability (overturning, sliding), stress and material failure
4.2.7 Seepage Control and foundation treatment in Dams : Types of grouting and drainage and their necessity,
4.2.8 Embankment Dam Analysis-phreatic line and seepage analysis.
4.3 Intakes - General arrangement of Intakes for storage plants, Location, Hydraulics of intake
4.4 Spillways and Energy Dissipaters
4.4.1 Purpose of spillways, general arrangement, types, and hydraulics (sizing) of spillways, Cavitation in spillways, preventive measures
4.4.2 Methods of dissipating energy below a dam, stilling basin, ski-jump and flip buckets, their suitability, hydraulics of stilling basin, the role of tail-water in energy dissipation
4.5 Types of gates and their location.

5. Headworks of Run-of- River (RoR) Plants (10 hours)

5.1 General Arrangement of components of a typical RoR plant: Spillways, undersluices, intakes with examples
5.2 General requirements of a functional RoRheadworks
5.3 Intakes of RoRheadworks: Location, Non pressure and pressurized intakes, General arrangement of intake, Control of bed load and floating debris in RoR intakes
5.4 Sediment Handling measures: Methods of bed load and suspended load handling in RoRheadworks, Design of settling basin (Particle and concentration approach), Estimation of sediment volume in Settling basin, Flushing of deposited sediment, estimation of frequency of flushing

6. Water Conveyance Structures (8 hours)

6.1 Hydraulic Tunnels, Geometrical shapes, hydraulic design (velocities, sizing), tunneling method, supports in tunnels, lining of tunnels
6.2 Forebay and Surge Tanks: importance, general arrangement, condition of their application, hydraulic design
6.3 Penstocks and Pressure shaft: importance, conditions of their application, general arrangement, hydraulic transients (water hammer), Computation of hydrodynamic pressure, sizing of penstock /pressure shaft and estimation of thickness of steel in penstock/pressure shaft

7. Hydro-electricMachines (6 hours)

7.1 Hydro-mechanical Equipment
7.1.1 Hydro-mechanical installation in powerhouse
7.1.2 Type of turbines, Pelton, Francis, Kaplan and Bulb turbines and their performance characteristics
7.1.3 Selection of turbines and their specific speed, Turbine setting

7.1.4 Preliminary design of francis and pelton turbines
7.1.5 Scroll case and draft tubes, their importance,

7.2 Electro-mechanical installation
7.2.1 Generators and their types, Rating of generators
7.2.2 Purpose and working principle of Governors

7.3 Pumps
7.3.1 Introduction to Centrifugal and reciprocating pumps, their performance characteristics

8. Powerhouse **(2 hours)**

8.1 Powerhouse types, general arrangement, dimension of powerhouse

Tutorial:

1. Chapter 2: (3 hours)
Preparation of alternative layouts of ROR plant on a given topographical map and assessing the most favorable one.

2. Chapter 3: (3 hours)
For the given plan and Profile (ACAD drawing or a hard copy drawing), estimation of power and energy based on the given flow and topographical data

3. Chapter4: (8 hours)
- Gravity dam analysis
- Stability analysis of Earth dams
- Seepage Analysis in Earthen dams
- Design of intake of a storage hydropower plant with neat sketch
- Hydraulic Design of Spillways and stilling basin with neat sketch

4. Chapter5: (4 hours)
- Preparation of general arrangement of a headworks of a RoR Project
- Design of intake of a hydropower plant with neat sketch
- Design of settling basin of a hydropower plant with neat sketch

5. Chapter 6: (6 hours)
- Hydraulic Design of Forebay and preparation of plan and longitudinal sections
- Hydraulic Design of Surge Tank and preparation of plan and vertical sections
- Estimation of hydrodynamic pressure and steel thickness of penstock

6. Chapter 7: (4 hours)
- Selection of turbines based on head and discharge characteristics
- Preliminary dimensioning of turbines and accessories, spiral case, draft tubes and preparation of neat sketch

7. Chapter 8: (2 hours)
- Computation of power house dimensions based on hydro-mechanical equipment designed in Chapter 7.
- Arrangement of equipment and accessories with neat sketch (plan and section)

Practical:

1. Performance characteristics of a Pelton Turbine
2. Performance characteristics of a Francis Turbine
3. Working principle of centrifugal pump and its characteristics
4. Working principle of reciprocating pump and its characteristics

Excursion:

One day observation trip to a hydropower plant in the vicinity followed by a brief report.

References:

1. Dandekar and Sharma, "Water Power Engineering", VikasPublishin house, New Delhi
2. Novak, P. et al., "Hydraulic Structures", Taylor and Francis, London
3. Mosonyi, E., "Water Power Development, Volume 1: Low-head Hydropower Plants", Academia Kiado, Budapest
4. Mosonyi, E., "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. Garg S K, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi
7. Hydropower Development- Series (17 Volumes), Vol. 8, 9, 10, 12,13, 14, Norwegian Universty of Science and Technology (NTNU), Norway

ESTIMATING AND COSTING

CE 705

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 0

Course objective:

To provide basic knowledge of estimating and costing of civil engineering works; to analyze the rates and estimate the cost of various construction works.

1. Introduction **(3 hours)**

1.1 Definition
1.2 Estimated Cost and Actual Cost
1.3 Purpose of Estimating
1.4 Principle of Units and Measurement
1.5 Units of Measurement and Payment for Various Items of Works and Materials
1.6 Data Required for Estimating

2. Method of Estimating **(5 hours)**

2.1 Method of Measurements of Building and Civil Engineering Works
2.2 Subheads of Various Items of Works
2.3 Various Methods of Taking Out Quantities
2.4 Abstracting Bill of Quantities
2.5 Preparation of Detailed Estimate: Cost of Items, Contingencies, Work Charged Establishment

3. Types of Estimate **(3 hours)**

3.1 Approximate Estimate
3.2 Detailed Estimate
3.3 Revised Estimate
3.4 Supplementary Estimate
3.5 Annual Repair and Maintenance Estimate
3.6 Extension and Improvement Estimate
3.7 Complete Estimate
3.8 Split Up of Cost of Building and Road Works, Water Supply and Sanitary Works.

4. Analysis of Rates **(9 hours)**

4.1 Introduction
4.2 Purpose of Rate Analysis

4.3 Importance of Rate Analysis
4.4 Requirement of Rate Analysis
4.5 Factors Affecting the Rate Analysis
4.6 Method of Preparing Rate Analysis for
  4.6.1 building works
  4.6.2 road works
  4.6.3 sanitary and water supply works
  4.6.4 irrigation works

5. Project Estimate **(5 hours)**

5.1 Estimate for a Project
5.2 Report on Estimate
5.3 Estimate for Building Project
5.4 Estimate for Road Project
5.5 Estimate for Irrigation Project
5.6 Estimate for Small Sewerage Project
5.7 Estimate for Water Supply Project

6. Detailed Estimate **(20 hours)**

6.1 Detailed Estimate for a Single-Room Load Bearing and Frame Structured Building
6.2 Detailed Estimate of a Two-Room Load Bearing and Frame Structured Building
6.3 Estimate of Earth Work in Road Construction in Plain Area
6.4 Estimate of Earth Work in Road Construction in Hilly Area
6.5 Estimate of Earth Work in Canals
6.6 Estimate for the Construction of Highway for One km Length
6.7 Estimate for Slab Culverts
6.8 Estimate of a Well Foundation
6.9 Estimate of a Pier
6.10 Estimate for T-Beam Decking
6.11 Estimate for Septic Tank and Soak Pit
6.12 Estimate of an Underground R.C.C. Water Tank

Tutorial: **(15 hours)**

1. A Double Storied Residential Building
2. A Portion of Road Way
3. A Portion of Canal with Lining
4. Application of Program to Estimate the Quantities of Materials
5. Application of Program to Calculate the Volume of Earth Work for a Roadway
6. A Residential Toilet

References:

1. M. Chakraborti, " Estimating, Costing, Specification and Valuation",
2. G.S. Berdie, "Text book of Estimating and Costing (Civil Engineering)",
3. A.K. Upadhyaya, " Estimating and Costing",
4. Seymour Berger and Jules B. Godel, " Estimating and Project Management for Small Construction Firms",

PROJECT WORK – I
CE 707

Lecture : 0
Tutorial : 0
Practical : 3

Year : IV
Part : I

Course Objective:

The objective of the project work is to equip the students with skills required to synthesize comprehensively the knowledge gained during course works for a practical application of civil engineering discipline in real life. Under the supervision and guidance of member/members of faculty each student is required to carry out an individual or group project which provides opportunities for tackling problem to civil Engineering and is required to submit a project report.

The choice of project will depend upon the interests of students, faculty and the facilities available in the campus.

A project may involve:

1. Preparation of a design for an extensive Civil Engineering project
2. Preparation of a Dissertation involving a literature survey and a correlation of existing knowledge
3. An experimental investigation

The project work is divided into two parts, viz Project –I and Project –II. In Project-I students are required to complete following works for above mentioned categories of project works:

1. Design type project
   - 1.1. Background
   - 1.2. Project Description
   - 1.3. Study Area
   - 1.4. Literature Review/Guidelines etc.
   - 1.5. Methodology
   - 1.6. Field data collection and plotting
2. Dissertation type project
   - 2.1. Background
   - 2.2. Need of the research
   - 2.3. Objectives and scope of the work
   - 2.4. Literature Review
   - 2.5. Study area
   - 2.6. Methodology
   - 2.7. Data collection and compilation

3. Experimental type project
   - 3.1. Background
   - 3.2. Need of the research
   - 3.3. Objectives and scope of the work
   - 3.4. Literature Review
   - 3.5. Experimental setup
   - 3.6. Methodology
   - 3.7. Data collection and compilation

In the initial phase the faculty may conduct a number of lectures and discussions as to the approach of the project. In the later phase, the student will be left on his own to pursue his work and to consult the faculty whenever any problem crops up. He/She should then submit a draft report prior to the final report so that the supervisor can correct the mistakes. The final report should be submitted to the Department Head in duplicate.

ELECTIVE I

STRUCTURAL DYNAMICS

CE 72501

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

To provide fundamental concepts of structural dynamics, and the dynamic behavior of structures along with the underlying principles, necessary to deal with the dynamic problems of structures.

1. Introduction: **(4 hours)**

1.1 Time Dependent Problems.
1.2 Types of Dynamic Loading.
1.3 Degrees of Freedom
1.4 Simple Harmonic Motion
1.5 Structural Vibration
1.6 Damping
1.7 Types of Vibration
1.8 Response of Structures to Vibration

2. Single Degree Of Freedom (SDOF) System **(12 hours)**

2.1 Equations of Motion and Natural Frequency
2.2 Modeling of SDOF Structures
2.3 Undamped Free Vibration Response
2.4 Critically - Damped, Under - Damped and Over - Damped Systems
2.5 Damped Free Vibration Response
2.6 Logarithmic Decrement
2.7 Forced Harmonic Response
2.8 Vibration Isolation and Force Transmissibility
2.9 Vibration Measuring Instruments
2.10 Energy Dissipated by Damping
2.11 Forced Vibration Response to Periodic Forces
2.12 Forced Vibration Response to Impulsive Forces
2.13 Forced Vibration Response to General Dynamic Loading
2.14 Convolution Integral and Duhamel Integral
2.15 Time Domain Analysis
2.16 Frequency Domain Analysis

3. Multi Degree Of Freedom (MDOF) System **(14 hours)**

3.1 Simple MDOF Systems
3.2 Reduction of DOF's and Static Condensation
3.3 Modeling of MDOF System Structures
3.4 Concept of Generalized Coordinate
3.5 Lagrange's Equations of Motion
3.6 Free Vibration Analysis of Undamped MDOF System
3.7 Natural Vibration Frequencies and Mode Shapes
3.8 Modal Expansion
3.9 Free Vibration Response of MDOF Systems
3.10 Normal Coordinates and Normal Mode Theory
3.11 Uncoupled Equations of Motion
3.12 Mode Superposition Method
3.13 Dynamic Analysis of Linear MDOF Systems
3.14 Modal Response Analysis of Undamped and Damped Systems
3.15 Element Forces
3.16 Modal Contribution Factors.
3.17 Forced Vibration Response of MDOF System
3.18 Practical Methods to Determine Natural Frequencies and Mode Shapes (Rayleigh's Method, Stodola's Method, Holzer's Method)

4. Linear Dynamic Analysis for MDOF System **(7 hours)**

4.1 Time Domain Analysis for General Dynamic Loading
4.2 Frequency Domain Analysis for General Dynamic Loading
4.3 Frequency Domain Analysis for Support Motion

5. Continuous Systems **(8 hours)**

5.1 Partial Differential Equations of Motion (for String, Bar, Beam)
5.2 Transverse Vibration of a String
5.3 Transverse Vibration of a Beam
5.4 Axial Vibration of a Bar
5.5 Approximate Methods to Determine Natural Frequencies and Mode Shapes in caseswhereOrthogonality Conditions are not satisfied.

Tutorial/Practical:

1. Each of the students shall work on a number of individual assignments with problems following the progress of the lectures.
2. The assignments will generally be related to the application ofsoftware packages, such as,FORTRAN,Matlab, Mathematica and SAP 2000.

3. All the assignments shall be submitted within the prescribed time, and will be evaluated as the practical work.

References:

1. Clough R. W., Penzien J, "Dynamics of Structures", McGraw Hill.
2. Chopra A. K., "Dynamics of Structures : Theory and Applications to Earthquake Engineering", Prentice Hall.
3. Paz, M.,and Leigh, W., "Dynamics of Structures– Theory and Computation", Kluwer Academic Publisher.,
4. Thompson, W. T., "Theory of Vibration with Applications", Prentice-Hall.

SEISMIC RESISTANT DESIGN OF MASONRY STRUCTURES

CE 72502

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

- To comprehend the fundamental principles of masonry behavior during earthquake
- To understand the mechanics of masonry elements subjected to various load effects including bending, shear, and axial forces.
- To discuss the code principles of masonry structures and apply them in design of masonry structures
- To design safe and efficient masonry structures from seismic viewpoint

1. Fundamentals of Earthquake Engineering **(8 hours)**

1.1 Origin of Earthquake
1.2 Nature of Earthquake Force
1.3 Earthquake Force Parameters
1.4 Earthquake as Lateral Force in Building
1.5 Time History, Frequency Spectra and Response Spectra of Earthquake Force

2. Introduction to Masonry and Non-Engineered Construction **(4 hours)**

2.1 Nature of Masonry Structures
2.2 Mechanical and Physical Properties of Bricks and Walls
2.3 Types of Masonry Structures: Load Bearing Walls, Infill Masonry and Confined Masonry
2.4 Elements of Masonry Structures

3. Response of Masonry Structures to Earthquakes **(5 hours)**

3.1 Lateral Force Resisting Systems
  3.1.1 In Plane and Out-of-Plane Behavior
  3.1.2 Typical Damages to Masonry Buildings in Earthquakes
  3.1.3 Modes of Failure of Masonry Structures

4. Seismic Analysis and Design of Masonry Buildings **(12 hours)**

4.1 Design Principles and Code Specifications for Masonry Construction
4.2 Design for Axial Load and Bending
4.3 Slenderness Effects
4.4 Design for Shear
4.5 Seismic Design of Masonry Shear Walls

5. Reinforced Masonry **(10 hours)**

5.1 Introduction to Reinforced Masonry
- 5.1.1 Flexural Strength
- 5.1.2 Shear Strength of Reinforced Masonry
- 5.1.3 Reinforced Masonry Columns and Beams

6. Repair and Strengthening Techniques for Damaged Masonry Buildings after Earthquakes **(6 hours)**

Tutorial:

1. Design of Walls for Gravity Load (Review)
2. Calculation of Lateral Load from Code
3. Design of Walls
4. Design of Reinforced Masonry Walls (Flexure and Shear)

Practical / Project Work:

Design a 2-3 storey masonry building considering seismic load.
(The students should carry out survey of masonry building and select one of the buildings for design. Each student shall submit design for unique building.)

References:

1. T. Paulay, M. J. N. Priestley, "Seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley & Sons, Inc., New York.
2. W. Hendry, B. P. Sinha, S. R. Davies, "Design of Masonry Structures", E & F N Spon, Londn UK.
3. S. Sahlin, "Structural Masonry", Prentice Hall, Engelewood Cliffs, New Jersey.
4. W. Hendry, "Structural Masonry", Macmillan, Houndmills, Basingstoke.
5. Tomazevic, M, "Earthquake-resistant Design of Masonry Buildings", Imperial College Press.
6. Arya A, Boen T, Ishiyama Y, Martemianov A, Meli R, Scawthorn C, Vargas J and Yaoxian Y , "Guidelines for Earthquake Resistant Non-engineered Construction",

TRAIL SUSPENSION BRIDGE

72503

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives

- To introduce trail suspension bridge
- To make capable to plan, analyse, design and construct trail suspension bridge

1. Introduction **(2 hours)**

1.1 Historical Background
1.2 Trail Bridge in Nepal
1.3 Classification of Trail Bridges and their Components

2. Essential Data for Design and their Acquisition **(6 hours)**

2.1 Essential Data for Design
2.2 Socio-Economic Study
2.3 Topographic Study and Engineering Survey
2.4 Geological and Geotechnical Study

3. Design of Trail Suspension Bridge **(26 hours)**

3.1 Cable
  3.1.1 Introduction to Cable and its Specifications
  3.1.2 Cable Geometry and its Analytical Presentation
  3.1.3 Deformation of Cable and its Calculation
  3.1.4 Nonlinear Analysis of Extensible Cable
3.2 Design of Main Cable Structure
  3.2.1 Cable Structure Design of Suspended Bridges
  3.2.2 Cable Structure Design of Suspension Bridges
3.3 Design of Wind Bracing Structure
  3.3.1 Wind Guy Cable Arrangement
  3.3.2 Design of Wind Guy Structure
3.4 Design of Suspenders/Hangers
3.5 Design of Towers
3.6 Design of Tower Foundation and Cable Anchorage
3.7 Design Calculation of Trail Suspension Bridge by Computer

4. Estimating and Costing **(2 hours)**

4.1 Rate Analysis
4.2 Cost Estimate

5. Construction of Trail Suspension Bridge **(9 hours)**

5.1 Construction Planning

5.2 Setting Out of the Bridge
5.3 Transportation, Handling and Hoisting of Cable
5.4 Fabrication and Erection/Construction of Bridge
5.5 Test Operation and Commissioning
5.6 Maintenance of Bridge

Tutorial:

1. Design Exercise on Cable Structure of N and D Type Bridges (8 hours)
2. Design Exercise on Tower (4 hours)
3. Design Exercise on Tower Foundation and Cable Anchorage (3 hours)

Practical:

1. Practical of the course consists of a minor project work and field work.
2. Every individual student is assigned with a minor project work on design of D / N type Trail Bridge and student has to defend the project work at the end of academic semester.
3. One day field visit to bridge sites is organised. Student has to submit a visit report.

References:

1. Survey, Design and Construction of Trail Suspension Bridges for Remote Areas
   Volume A: **Design**, F. Grob, J. Krähenbühl, A. Wagner
   Volume B: **Survey**, J. Krähenbühl, A. Wagner
   Volume C: **Standard Design Drawings**, C. B. Basnet, J. Krähenbühl
   Volume D: **Execution of Construction Works**, D. Panciotto
   Volume E: **Costing and Contracting**, J. Krähenbühl
2. **Trail Suspension Bridges** (Course Manual), SBD,DOR & IOE
3. **Short-span Trail Bridge Standard**, Technical Handbook, Trail Bridge Section, GoN

BIO-ENGINEERING

CE 72504

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

The course is aimed at providing the alternative approach to the slope stabilization techniques using living vegetation. After the completion of the course, the students will be able to analyze the slope stability based on various parameters and use soil bioengineering techniques for the purpose of erosion control and stabilization of the shallow seated instability. They will also gain the knowledge of appropriate technology and its significance in the development of rural infrastructures in Nepal, in the field of hill roads.

1. Introduction to Bio-engineering **(4 hours)**

1.1 Glimpses of landslides and scenario of soil erosion in Nepal
1.2 Identification of problems on slopes
1.3 Engineering functions to be performed
1.4 Materials to be used for slope protection and stabilization works
1.5 Use of vegetation as a slope stabilizing material
1.6 Definition of Soil Bio-engineering
1.7 Justification of Bioengineering
1.8 Field of application and scope
1.9 Advantages and limitations

2. Site Investigation **(10 hours)**

2.1 Analysis of slope stability based on the mineral types
2.2 Analysis of the slope stability based on the orientation of fracture and joints
2.3 Analysis of the slope stability based on weathering grade of rock
2.4 Analysis of the slope stability based on the rock types
2.5 Types of slope materials and its relationship with slope failure
2.6 Introduction to mass movements and its classification
2.7 Introduction to landslides
2.8 Causes and mechanism of slope failure
2.9 Landslide mapping
2.10 Assessment of seriousness
2.11 Priorities of repair

3. Basic Aspect of Vegetation **(4 hours)**

3.1 Plant types, plant form and structures
3.2 Vegetation and plant community
3.3 Basic requirements of plants
3.4 Plant propagation

4. Role of Vegetation **(6 hours)**

4.1 Hydrological effects
4.2 Hydraulic effects
4.3 Mechanical effects
4.4 Soil strength and stability analysis

5. Plant Species Selection **(4 hours)**

5.1 Distributions of plants in Nepal
5.2 Criteria for species selection
5.3 Selection of plant types depending upon the Drought factor

6. Vegetative Stabilization Techniques **(6 hours)**

6.1 Vegetative engineering systems
6.2 Design of vegetative techniques

7. Small Scale Civil Engineering Systems **(4 hours)**

7.1 Engineering systems
7.2 Selections of engineering systems
7.3 Interactions between vegetative and civil engineering systems

8. Optimal Technique **(2 hours)**

8.1 Site categorization
8.2 Selection of optimal technique

9. Nursery **(4 hours)**

9.1 Nursery establishment
9.2 Nursery technique

10. Management **(1 hour)**

10.1 Importance of seasonal programming

Tutorial:

Detail Analysis of slope stability

Practical:

1. **Landslide Mapping in the Field.**
   1.1. Map the site.
   1.2. Find out the causes and mechanism of failure.
   1.3. Prepare the proposal for the treatment.
2. **Examination of Bio-engineering Systems in the Field.**
   2.1. Map the site of bioengineering implementation.
   2.2. Analyze the strengths and weaknesses of the site.
   2.3. Suggest the further improvements.
3. **Examination of Civil Engineering Systems in the Field.**
   3.1. Map the site of civil engineering systems.

3.2. Analyze the strengths and weaknesses of the site.
3.3. Suggest the further improvements.

4. **Interaction between Civil and Bio-engineering Systems.**
   4.1. Evaluation of compatibility of civil and bioengineering systems.

Note: 15 hours in the field and 7.5 hours report presentation

References:

1. Donald H. Gray, Robin B. Sotir, "Biotechnical and Soil Bioengineering Slope Stabilization a Practical Guide for Erosion Control",
2. N.J.Coppin, I.G.Richards, "Use of Vegetation in Civil Engineering",
3. R.P.C.Morgan, "Soil Erosion and Conservation",
4. "Roadside bioengineering: site handbook", Reference manual
5. R.P.C.Morgan, R.J. Rickson, "Slope stabilization and erosion control: A bioengineering Approach",

ROCK ENGINEERING

CE 72505

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

The objective of the course is to equip with skills & tools required for analysis and design of underground opening and related structures applicable to Hydropower development.

1. Background **(1 hour)**

1.1 The role of rock engineering in hydropower development
1.2 Main elements of hydropower plants

2. Properties of Rocks and Rock Masses **(4 hours)**

2.1 Introduction
2.2 Physical properties of rocks
2.3 Strength of rocks
2.4 Jointing of the rock mass
2.5 Shear strength of joints
2.6 Weakness zones and faults

3. Rock Stresses **(6 hours)**

3.1 Introduction
3.2 Origin of rock stress
3.3 Stresses surrounding underground opening
3.4 Stability problem due to stress
3.5 Rock stress measurements

4. Groundwater in Rock Masses **(4 hours)**

4.1 Introduction
4.2 Permeability and hydraulic conductivity
4.3 Estimation of water leakages
4.4 Field measurements
4.5 Problems caused by water

5. Engineering Geological Investigation for Underground Structures (6hours)

5.1 Introduction
5.2 Investigation stages
5.3 Pre-construction phase investigations
5.4 Construction phase investigations
5.5 The Engineering Geological Report

6. Rock Mass Classification **(6 hours)**

6.1 Introduction
6.2 Quality rating and support estimation
  6.2.1 The RMR system
  6.2.2 The Q-system
  6.2.3 The RMi-support method
6.3 Comments on classification systems for rock support estimates

7. Design Approach of Underground Opening **(4 hours)**

7.1 Introduction
7.2 Shallow seated and deep-seated opening
7.3 Design procedures
7.4 General Recommendations

8. Support and Lining **(2 hours)**

8.1 Introduction
8.2 Support methods and principles
8.3 Evaluation of support requirements

9. Stability of Rock Slopes **(10 hours)**

9.1 Classification of stability problems
9.2 Factors affecting the stability
9.3 Stability analysis
9.4 Consequences of erroneous input data

10. Improved and Cost Saving Solutions **(2hours)**

10.1 Introduction
10.2 Underground high-Pressure Tunnels and Shafts

Tutorial:

1. Stresses surrounding underground opening
2. Estimation of water leakages in rock mass
3. Presentation of geological data (Joint rosette, Mode of failures)
4. Estimation of the rock support for underground structures

Practical:

1. One day field visit
2. Rock slope stability analysis

Field Visit: **(2 days)**

Field Visit to hydropower project in the vicinity. Field report and group presentation is required.

References:

1. Nilsen, B. and Thidemann, A, "Rock Engineering", Norwegian University of Science and Technology, Trondheim, Norway, 156p.
2. Nilsen, B. and Palmstrom, A, "Engineering Geology and Rock Engineering", Norwegian Group of Rock Mechanics (NBG), Norway, 249p.
3. Hoek, E. and Bray, J. W. , "Rock Slope Engineering". Institute of Mining and Metallurgy, London, 358p

SOIL CONSERVATION AND WATERSHED MANAGEMENT
CE 72506

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

To make students able to estimate the runoff and soil loss, design contour bunds, grassed waterways, terraces, drainage structures, gully control structures, small storage structures etc. and prepare watershed management plan.

1. Introduction **(2 hours)**

1.1 Need of Soil and Water Conservation - Problems of Soil Erosion and Land Slides; Need of Soil and Water Conservation
1.2 Concept and Approaches of Watershed Management - Concept of Management on Watershed Basis; Vegetative and Engineering Approaches
1.3 Watershed Operations - Physiography; Rainfall-Runoff Analysis; Measures and Operations

2. Runoff and Soil Loss **(5 hours)**

2.1 Soil and Water - Soil Characteristics (Composition, Profile, Texture and Structure); Infiltration and Soil Moisture Conditions; Surface Runoff and Ground Water; Mechanics of Erosion)
2.2 Types of Soil Erosion and Land Slides - Surface Erosion; Gully Erosion; Stream Bank Erosion; Land Slides and Movement
2.3 Runoff Computations - Rational Methods; Regional methods
2.4 Soil Loss Computations - Soil Loss Factors; Universal Soil Loss Equation (USLE)

3. Land Capability for Watershed Management **(2 hours)**

3.1 Land Capability Classification (LCC)
3.2 Characteristics of Land Capability
3.3 Land Use and Soil Conservation Practices

4. Agronomic Measures for Soil and Water Conservation **(4 hours)**

4.1 Contour Cultivation
4.2 Strip Cropping
4.3 Conservation Farming: Tillage Conservation; Crop Rotation; Multiple Cropping; Cover Crop
4.4 Farm Yard Manure (FYM); Use of Micro irrigation Methods
4.5 Grassland Farming
4.6 Agro-Forestry
4.7 Horticulture

5. Engineering Measures for Conservation of Agriculture Land (9 hours)

5.1 Bunding - Types (Contour Bunding and Graded Bunding); Design Criteria and Specification of Bunding; Design of Contour and Graded Bunding; Construction and Maintenance of Bunding

5.2 Terracing - Types (Bench Terraces and Broad Base Terraces); Design of Bench Terraces; Design of Broad Base Graded Terrace; Construction and Maintenance of Terraces

5.3 Drainage Structures and Grassed Waterways - Types of Surplus Drainage Structures; Design of Surplus Weir and Pipe Outlets; Design of Grassed Waterways; Construction and Maintenance of Grassed Waterways

6. Engineering Measures for Conservation of Non-Agriculture Land(7 hours)

6.1 Contour and Staggered Trenching

6.2 Gully Control Structures: Types of Gully Control Structures; Temporary and Semi-Permanent Check Dams; Permanent Spillway Structures; Design of Straight Drop, Drop Inlet and Chute Spillways

6.3 Sediment Retention Structures

6.4 Soil and Water Retaining Structures - Design of Water Retaining Structures

7. Bio-Engineering for Soil and Water Conservation (3 hours)

7.1 Vegetative Conservation Techniques - Fascines; Palisades; Wattling; Bamboo Planting; Grass planting; Live Fencing; Brush Layering

7.2 Natural Hazard Prevention - Gully Treatment; Land Slide Treatment; Stream Bank Protection; Degraded Land Rehabilitation

7.3 Protection of Developed Infrastructure - Irrigation Channel Stabilization; Trail Improvements; Road Slope Stabilization; Water Source

8. Water Conservation and Harvesting (7 hours)

8.1 Water Conservation for Cropland - Broad Bed and Furrow System (BBF); Conservation Bench Terraces (CBT); Tied Ridging or Furrow Damming; Contour Furrows; Catch Pits

8.2 Small Storage Structures - Conservation Ponds; Small Weirs; Small Earthen Dams with Design; Sand Dams

8.3 Recharge and Use of Ground Water

9. Watershed Management (6 hours)

9.1 Causes and Consequences of Watershed Deterioration

9.2 Objectives and Steps of Watershed Management

9.3 People's Participation in Watershed Management

9.4 Watershed Management Plan (WMP)

9.5 Formulation of Project Proposal

Tutorial:

1.	Estimation of Soil Loss by USLE	(2 hours)
2.	Design of Contour and Graded Bunding	(2 hours)
3.	Design of Bench Terraces	(1 hour)
4.	Design of Broad Base Graded Terrace	(1 hour)
5.	Design of Surplus Weir and Pipe Outlets	(2 hours)
6.	Design of Grassed Waterways	(2 hours)
7.	Design of Straight Drop and Chute Spillway	(2 hours)
8.	Design of Water Retaining Structure	(2 hours)
9.	Design of Small Earthen Dam	(1 hour)

Practical/Assignment:

Individual assignment on delineation of watershed boundary and preparation of Watershed Management Plan(WMP) (22.5 hours)

References

1. "Soil Conservation and Watershed Management Measures and Low Cost Techniques" NARMSAP NEPAL & Department of Soil Conservation and Watershed Management, Kathmandu.
2. E.M. Tideman, "Watershed Management: Guidelines for Indian Conditions", Omega Scientific Publishers, New Delhi.
3. R. Suresh, "Soil and Water Conservation Engineering", Standard Publishers Distributors, New Delhi.

EARTH HAZARD

CE 72507

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

The main objective of the course is to provide knowledge on various types of Earth Hazard and their process and assessment in order to be capable of appreciating their effects on infrastructures when the students design engineering structures. At the end of the course the students will be able to

- Differentiate the types of Earth Hazard
- State geological processes of various types of Earth Hazards
- Analyse the Causes, Mechanisms and effects of earth hazards
- Classify and prepare hazard maps for different types of Earth Hazards

1. Introduction to Earth Hazards **(4 hours)**

Concepts on Danger, Hazard, Risk and Disaster: Methods Assessment, Implications in engineering structure and designs,Geomorphological subdivision of the Himalayas, and their specific hazards, Introductionto factors controlling earth hazards: geological, hydrological, land use and groundwater

2. Geological Factors Controlling Natural Hazards **(8 hours)**

Geological structures: Classification and nomenclature of folds, fractures, joints and faults; fault zone topography, Basics of rock and soil mechanics, Strength of rock and rock masses, Structure and failure mechanics in rocks.

3. Glacial and Flood Hazards **(7 hours)**

Flow regime, Sediment erosion, transportation and deposition, glacial landforms, glacial lakes and Glacial Lake Outburst Floods, Flood and debris flow, Definitions, Sedimentation, flood routing and assessment and predictions of flood damages.

4. Earthquakes **(4 hours)**

Definition, nature and motion, intensity and magnitude, intensity scale, Causes and distribution in the Himalayan reason, Earthquake intensity distribution maps, Introduction to seismic hazards assessments.

5. Earth Mass Movement Hazards **(10 hours)**

Definition of landslide, mass movement, and mass wasting, Parts of the mass movement, Varnes' classification of mass movements, Description of main landslide types, Landslide Hazard Analysis- Ground investigation, sampling, laboratory testing techniques; Application of bio-engineering in slope stabilization.

6. Techniques and Application of Hazard Mapping in the Field (12 hours)

Criteria for identification of Earth Hazards in the field, Identification of hazard features, Direct and Indirect Mapping, Use of remote sensing (Aerial photographs and Satellite imageries) and Geographic Information System tools in hazard mapping, Application of hazard maps in planning and designing of engineering infrastructures.

Tutorial:

Detail analysis of Landslide hazard.

Practical:

1. Landslide Mapping in the Field:
   - 1.1. Map the site.
   - 1.2. Find out the causes and mechanism of failure.
   - 1.3. Prepare the proposal for the treatment.
2. Identification of Earth Hazard in the Field.
   - 2.1. Identification of features
   - 2.2. Direct mapping
   - 2.3. Interpretation of Hazard Maps

Note: 15 hours in the field and 7.5 hours report presentation

Reference:

1. Deoja B., Dhital M. , and Thapa B, "Mountain Risk Engineering Handbook, Vol 1 and 2", ICIMOD, Kathmandu, Nepal 875pp.
2. YBDRO , " Mitigating Natural Disaster: Phenomira Effect and Options, a Manual for Policy Makers and Planners", United Nations. New York, 164PP.
3. Terzaghi, k. peck, R.B., " Soil Mechanics in Engineering Practice", John Wiley and Sons Inc. 729pp.
4. Linsley, Kohler Penehus, "Hydrology for Engineers", Mc. Graw-Hill.
5. Department of Roads, " Bioengineering for Road Engineer's Training Module Vol 1 and 2", DOR/HMG Nepal, 1227pp.
6. Brunsden Prior (Editors), "Slope Instability"

TRANSPORTATION PLANNING AND ENGINEERING
CE 72509

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

The course is aimed at teaching the students the planning type, process analysis and different transportation systems.

1. Introduction **(6hours)**

1.1 Scope of transportation planning and transportation system engineering
1.2 Organizational structure of Ministry of Works and Transport and its departments
1.3 The decision making process in transportation for planning, design, implementation, monitoring and development of transportation facilities
1.4 Model characteristics and roles
1.5 Simulation techniques and their scientific approach to model development
1.6 Transportation networks: their characteristics and analysis

2. Urban and Regional Transportation Planning **(4hours)**

2.1 Difference between urban and regional planning
2.2 Differences in planning for movement of people and goods
2.3 Hierarchical structure to transportation planning: intermodal approach and integrated development approach
2.4 Transport demand surveys and studies: survey design and field studies, data requirements for passenger and freight movements
2.5 Predicting future demand

3. Urban Transportation Planning Process **(8hours)**

3.1 Planning phases: trip generation, trip distribution, modal split and traffic assignment
3.2 The supply side of transportation: the modes, their roles and characteristics (capacity, cost etc.)
3.3 Other recent approaches to transportation planning

4. Transportation System Analysis **(2hours)**

4.1 Generation of alternatives
4.2 Evaluation of alternatives and criteria
4.3 Selection considerations: capital and operating expenditures etc.

5. Introduction to Airport Engineering **(10hours)**

5.1 Airport classification: international, domestic, general aviation, military

5.2 Aircraft types: jet, propeller, number of engines etc.
5.3 Predicting air travel demand
5.4 Selection of airport site
5.5 Layout of the airfields and their geometric standards
5.6 Terminal facilities and their space requirements
5.7 Introduction to the design of airfield pavements

6. Introduction to Railway Engineering **(10hours)**

6.1 Classification of railways
6.2 Components of the railway section
6.3 Geometric design of railway track
6.4 Design of track structure
6.5 Railway switches and crossings
6.6 Railway side tracks and yards

7. Ropeways in Nepal **(5hours)**

7.1 Introduction
7.2 Gravity goods ropeways
7.3 Existing planning process

Tutorial:

1. Urban transportation planning process: trip generation, trip distribution, modal split, traffic assignment (4 hours)
2. Airport runways design (3 hours)
3. Airport taxiway design (2 hours)
4. Geometric design of railway (2 hours)
5. Design of track structure (2 hours)
6. Design of gravity goods ropeways (2 hours)

Practical/assignment:

In these sections, students are asked to prepare report regarding the current state of affairs on the subjects related to air transportation, rail transportation, ropeway and/or any other modes of transportation in the local context. Students are required to present the report for evaluation which will be the part of assessment marks. Depending upon the nature of subject matter, students can be grouped (with a maximum of 4 students per group) for the submission and subsequent presentation.

References:

1. B.C. Hutchinson, "Principles of Urban Transportation Planning", McGraw Hill Publishing Company
2. E.K. Morlok, "Introduction to Transportation Engineering and Planning", International Student Edition, McGraw Hill Publishing Company.

3. Michael D. Meyer & Eric J. Miller, "Urban Transportation Planning", McGraw Hill,
4. S. K. Khanna, M.G. Arora, S.S. Jain, "Airport Planning and Design", Nem Chand and Bros. Roorkee.
5. S.C. Rangwala, "Principles of Railway Engineering", Charotar Publishing House Pvt. Ltd. India.
6. V.N. Vazirani and S.P. Chandola, "Transportation Engineering, Volume I and II", Khanna Publishers, Delhi, India.
7. "Technical Guidelines for Gravity Goods Ropeways", DoLIDAR.

ROPEWAY ENGINEERING

CE 72510

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

- To introduce ropeway transport, types of ropeway and their components.
- To make acquainted with the planning, analysis, design and construction of aerial and surface ropeway for passengers.
- To make capable to plan, analyse, design and construct gravity ropeway for goods.

1. Introduction **(2 hours)**

1.1 Historical Background of Ropeway Transport
1.2 Ropeway in Nepal

2. Types of Ropeways and their Components **(3 hours)**

2.1 Types of Ropeways
2.2 Surface Ropeway for Passengers
2.3 Aerial Ropeway for Passengers and Goods
2.4 Gravity Ropeway for Goods

3. Socio- Economic and Technical Study **(5 hours)**

3.1 Pre-Feasibility Study
3.2 Socio-Economic Study
3.3 Topographic Study and Engineering Survey
3.4 Geological and Geotechnical Study

4. Design of Ropeway System **(20 hours)**

4.1 General Design requirements and Design provisions
4.2 Wire-Rope Design
  4.2.1 Introduction to Wire-Ropes and their Specifications
  4.2.2 Loads on Wire-Rope
  4.2.3 Wire-Rope Geometry
  4.2.4 Deformation of Wire-Rope and its Calculation
  4.2.5 Nonlinear Behavior of Wire-Rope and its Analysis and Design
4.3 Design of Towers
4.4 Design of Tower Foundation and Wire-Rope Anchorage
4.5 Introduction to Electro-Mechanical System Design

5. Estimating and Costing **(2 hours)**

5.1 Rate Analysis
5.2 Cost Estimate

6. Planning, Construction and Maintenance of Ropeway System **(9 hours)**

6.1 Construction Planning
6.2 Setting Out
6.3 Construction Equipment
6.4 Transportation, Handling and Hoisting of Wire-Rope
6.5 Construction, Installation and Maintenance
6.6 Test Operation and Commissioning

7. Quality Control and Safety **(4 hours)**

7.1 Material Testing
7.2 Safety Measures

Tutorial:

1. Design exercise on wire-rope structure of aerial ropeway (6 hours)
2. Design exercise on wire-rope anchorage and tower foundation on soil and rock (4 hours)
3. Design exercise on tower structure (3 hours)
4. Estimating and costing of gravity goods ropeway (2 hours)

Project work:

Design of a gravity ropeway system.

Field work:

Two days visit to ropeway sites, fabricators' workshops, implementing agencies of ropeway and submission of a report.

References:

1. "Technical Guidelines for Gravity Goods Ropeway"; DoLIDAR, Ministry of Local Development
2. Gyawali, D. & Dixit, A, "Ropeways in Nepal",
3. "Technical Brief Gravity Ropeway", Practical Action Nepal
4. IS 9706:1997, IS code for aerial ropeway for transport of material
5. IS 5229:1998, IS code for aerial ropeway for transport of passengers
6. Approved code of practice for passenger ropeways in New Zealand, 1998

7. Aerial ropeways and funicular railways – ZBIGNIEW SCHINEIGET , Pergsmon press, Oxford London

8. M. Kazakevitch. Zakora, "Cable Stabilization for Wind and Moving Load Effect", Journal of Wind Engineering and Industrial Aerodynamics (1998)

SOLID WASTE MANAGEMENT
CE 72511

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objectives:

To provide knowledge regarding technological, organisational and legislative developments and practices of handling solid wastes by covering engineering and scientific concepts and principles applied to the management of municipal solid waste (MSW) to protect human health and the environment and the conservation of limited resources through resource recovery and recycling of waste material.

1. Introduction **(4 hours)**

1.1 Definitions of Terminology
1.2 Concept of Waste Management
1.3 Waste Generation in Different Types of Society
1.4 Solid Waste, Environment and Public Health
1.5 Development of Solid Waste Management
1.6 Development of Solid Waste Management in Nepal
1.7 Legislation Provision of Solid Waste Management in Nepal
1.8 Introduction to Integrated Solid Waste Management (ISWM)
1.9 3R Principles of Solid Waste Management

2. Sources and Types of Wastes **(7 hours)**

2.1 Sources of Municipal Solid Waste
2.2 Types of Municipal Waste, Garbage Rubbish, Trash, Street Sweeping and Others
2.3 Composition of Solid Waste
2.4 Waste Generation
2.5 Method of Estimating Waste Generation
2.6 Properties of Solid Waste
2.7 Physical Properties
2.8 Chemical Properties
2.9 Biological Properties
2.10 Introduction to Waste Transformation

3. Solid Waste Handling, Collection, Transfer and Transport **(9 hours)**

3.1 Waste Collection Planning
3.2 On-site Management
3.3 Storage of Waste
3.4 Collection Services
3.5 Collection Systems
3.6 Analysis of Collection System
3.7 Collection Routes

3.8 Transfer and Transport of MSW
3.9 Transfer Stations

4. Municipal Solid Waste Processing and Ultimate Disposal (13 hours)

4.1 Various Methods of Waste Disposal
4.2 Landfills, Sanitary Landfills, Combustors, Composting
4.3 Land Filling, Landfill Types, Methods and Operations, Planning Land Fill Sites, Landfill Sitting Consideration, Factors Affecting LF Site Selection,
4.4 Design, Operation and Monitoring of Landfill
4.5 Gas and Leachate Production and Management in Landfill
4.6 Health Consideration and Environmental Management of Municipal Solid Waste Disposal

5. Resource Recovery (10 hours)

5.1 Introduction to Resource Recovery
5.2 Material Separation and Processing Techniques
5.3 Materials Recovery Facilities
5.3.1 Unit Operation in MRF
5.4 Conversion Technology for Recovery
5.5 Biological Conversion
5.5.1 Composting , Vermicomposting
5.6 Recovery of Thermal Conversion Products
5.6.1 Incineration, Types and Design Consideration, Environmental Consideration

6. Overview of Waste Management Practices in Nepal (2 hours)

6.1 Present Waste Management Scenario in Nepal
6.1.1 Best Practices
6.1.2 Private and Community Participation
6.1.3 Recovery Process in Nepal
6.1.4 SWM and Climate Change Issues in Nepal

Tutorial:

1. Introduction (1 hour)
Definitions, Timeline Diagram of Development of Solid Waste Management in Nepal, Diagram of (ISWM) Component and Functional Element , Diagram of Hierarchy of ISWM, Highlight Feature of Legislation Provision in Nepal

2. Sources and Types of Wastes (3 hours)
Computation Method of Estimating Waste Generation, Proximate Analysis, Ultimate Analysis, Approximate Chemical (Energy) Formula, Computation of Physical Properties, Energy Value Using Dulong's Formula

3. Solid Waste Handling, Collection, Transfer and Transport (3 hours)
Computation of Vehicle Size, Container Size, Number Required, Location, Analysis of SCS, HCS,

4. Municipal Solid Waste Processing and Ultimate Disposal (4 hours)
   Land Fill Design Step, Numerical of LF Design, Numerical On Gas and Leachate Generation. Triangular model of leachate computation
5. Resource Recovery (2 hours)
   Numerical on Solid Waste Decomposition, Oxygen Requirement for Decomposition and Combustions.
6. Overview of Waste Management Practices in Nepal (2 hours)
   Field Visit Report

Practical/Field Visit:

One day field observation visit to observe collection, transfer station, transport and landfill operation and community participation practices of SWM of nearest municipalities

References:

1. George Tchobanoglous, KilaryTheisen, Samuel Vigil, "Integrated Solid Waste Management", Mcgraw-HillInc, International Edition.
2. Howard Peavy, Donald Rowe, George Tchobanoglous, " Environmental Engineering", Mcgraw Hill Inc, International Edition.
3. Frank Kreeith, "Handbook of Solid Waste Management", Mcgraw Hill Inc
4. Solid Waste Management in Urban Nepal: A Review
5. NPC/IUCN National Conservation Strategy Implementation Program
6. Integrated Resource Recovery in Municipal Solid Waste Management, The World Bank

WATER AND WASTEWATER QUALITY ANALYSIS

CE 72512

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical : 3/2

Course Objective:

To provide knowledge of field oriented water and wastewater sampling techniques, water quality analysis, and their utilization.

1. Introduction **(2 hours)**

1.1 Water quality,
1.2 WHO guidelines and national standard
1.3 Water pollution and its effects.

2. Sampling **(6 hours)**

2.1 Sampling and its techniques
2.2 Methods of sampling in river and lake,
2.3 Methods of sampling in drainage, river and lake
2.4 BOD, COD test sampling techniques
2.5 Analysis of domestic water and wastewater samples

3. Physical Parameters **(12 hours)**

3.1 Temperature
3.2 Color
3.3 Odor and taste
3.4 Turbidity
3.5 Total solids, fixed solids and volatile solids
3.6 pH
3.7 Conductivity
3.8 Salinity

4. Chemical Parameters **(12 hours)**

4.1 Alkalinity
4.2 Hardness
4.3 Arsenic
4.4 Cadmium
4.5 Calcium
4.6 Chloride
4.7 Chlorine
4.8 Chromium
4.9 Copper

4.10 Fluoride
4.11 Iron
4.12 Manganese
4.13 Mercury
4.14 Total - nitrogen, ammonia- nitrogen, nitrate- nitrogen
4.15 Phosphate
4.16 Potassium
4.17 Sulphate

5. Microbiological Parameters **(10 hours)**

5.1 Coliforms
5.2 E - coli

6. Analysis of Samples **(3 hours)**

6.1 Analysis of water samples for potable water
6.2 Analysis of wastewater samples with respect to effluent quality standards and other purposes
6.3 Probable solutions for solving impurities in water and wastewater

Tutorial:

1. Introduction (1 hour)
   Definitions, water quality, WHO guidelines and national standard
2. Sampling (1 hour)
   Definitions, sampling and its techniques in various cases
3. Physical parameters: (2 hours)
   Definitions, WHO guidelines and national standards, highest desirable level, maximum permissible level for various purposes.
4. Chemical parameters: (4 hours)
   Definitions, WHO guidelines and national standard, highest desirable level, maximum permissible level for various purposes.
5. Microbiological parameters : (4 hours)
   Definitions, WHO guidelines and national standards, highest desirable level, maximum permissible level for various purposes.
6. Analysis of samples : (3 hours)
   Analysis and probable solutions for solving impurities in water and wastewater

Practical:

1. Laboratory Works for the Determination of
   1.1. Physical Parameters
   1.2. Chemical Parameters
   1.3. Microbiological Parameters of Water and Wastewater Samples
2. Water Quality Standards and Functional Standards

References:

1. Andrew D. Eaton, Lenore S. Clesceri, and Arnold E. Greenberg, "Standard Methods for the Examination of Water and Wastewater".
2. A.K. Deo, "Environmental Chemistry"
3. WHO Guidelines for Drinking-water Quality.

COMMUNITY DEVELOPMENT AND PARTICIPATORY RURAL APPROACH

CE 72513

Lecture : 3 **Year : IV**
Tutorial : 1 **Part : I**
Practical 3/2

Course Objectives:

To make students able to understand the concept of community development, participatory rural appraisal (PRA) and communication techniques

1. Community Development **(10 hours)**

1.1 Participatory approach
1.2 Community participation and forms of community participation
1.3 Demand led approach
1.4 Community management
1.5 Sustainability
1.6 Community empowerment elements
1.7 Gender issues introduction
1.8 Population environment and quality of life
1.9 Skill development training; group formation
1.10 Saving, credit and micro credit
1.11 Community action plan.

2. Participatory Rural Appraisal (PRA) **(15 hours)**

2.1 Philosophy/principles of PRA;
2.2 Concept of PRA
2.3 Classification of PRA
2.4 Exploratory, topical, participatory, and monitoring PRA
2.5 Major PRA techniques (focus group discussion, informal discussion, participant observation, key information interview and conducting interviews
2.6 Stakeholders discussion
2.7 Resource mapping
2.8 Maps and modelling, matrix ranking
2.9 Wealth ranking
2.10 Participatory workshop
2.11 Advantages of PRA, tools and instruments such as triangulation
2.12 Time line, ethno-history
2.13 Seasonal calendar, pie-diagram, venn diagram
2.14 Statistical tools (SPSS)etc.

3. Communication **(10 hours)**

3.1 Art of communication;
3.2 Paraphrasing

3.3 Giving and taking feedback
3.4 Active listening
3.5 Reflection
3.6 Asking questions
3.7 Conflict resolution
3.8 Group dynamics
3.9 Counselling.

4. Case Studies **(10 hours)**

4.1 Farmers managed irrigation schemes
4.2 Community managed water supply systems.

Tutorial:

1. Introduction (3 hours)
   1.1. Development of community action plan health and diseases transmission in emergency settings:
   1.2. Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic,
   1.3. Design of hygiene campaigns
2. Participatory Rural Appraisal (PRA) (2 hours)
   2.1. Maps and modelling, matrix ranking,
   2.2. Wealth ranking
   2.3. Resource mapping
   2.4. Seasonal calendar
   2.5. Pie-diagram
   2.6. Venn diagram
   2.7. Communication : Participatory discussion (4 hours)
3. Case Studies (6 hours)
   3.1. Case studies on farmers managed irrigation schemes
   3.2. Case studies on community managed water supply systems.

Practical / Project work:

1. Concepts and development of Community action plan
2. Report preparation on PRA
3. Resource mapping
4. Maps and modelling, matrix ranking, wealth ranking
5. Seasonal calendar, pie-diagram venn diagram
6. Case studies on farmers/ community managed irrigation schemes

References:

1. Chambers Robert , "whose reality counts? Putting the first last", Intermediate Technology Publication, London.
2. Nelson, Nici and Susan Wright , "Power and Participatory Development, Theory and Practice", Intermediate Technology Publication, London.
3. Reid, David, "Sustainable Development, An introduction of Guide", Earthscan Publication ltd. London.

4. Slocum, Rechel. et. al (eds), "Power, Process and Participation- Tool for Change", Intermediate Technology Publication, London.
5. Baseline studies
6. Shrivastave, A. K., "Nature Conservation", APH Publishing Corporation New Delhi.
7. Jones, S., "Environment, Development and Rural Livelihood", Earthscan, London.
8. Oliver and Hidmore, "Climatology", Prentice Hall.