

## PROJECT ENGINEERING

CE ...

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.

### 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 Soft ware - 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

### Tutorials:

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" 2011, Chandeshwori Publication, First Edition.
- 2 DhurbaP.Rizal, "Project Management" 2001, Ratnapustakbhandar, First Edition.
- 3 E.R. Yescombe, "Principles of Project Finance" 2002, Yescombe-Consulting Limited.
- 4 K. Nagarajan, "Project Management", ISBN: 81-224-1340-4, New Age International (P) Limited, New Delhi, India, 2001.
- 5 Dr. Govinda Ram Agrawal, "Project Management in Nepal" Edition: 2006, M.K. Publishers and Distributors, Kathmandu, Nepal.

**Evaluation Scheme:**

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

Chapters	Hours	Marks Distribution *
1	6	10
2	8	12
3	12	24
4	7	12
5	7	12
6	5	10
Total	45	80

\* There may be minor deviation in marks distribution.

# DESIGN OF REINFORCED CONCRETE STRUCTURES

CE ....

Lecture : 4

Tutorial : 2

Practical : 2

Year : IV

Part : I

## Course Objective:

The purpose of this course is to provide the students knowledge and skill for design of different elements of a building structure using reinforced concrete. The course focuses on Limit State Methods of Design and the students will learn to use output of Structural Analysis to design different elements according to the codal provisions and detailing of the reinforcement. The course also includes key features of Seismic Building Code and provisions of ductile detailing in reinforced concrete structures.

- 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

### Tutorials

- 1. Design and detailing of rectangular and flanged beams
  - 1.1. Flexure [4 hours]
  - 1.2. Shear/ Tortion [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. 2002. Reinforced Concrete Limit State Design, Nem Chand and Bros, Roorkee, India (Reprint 2009)
- 2. Pillai, S.U., Menon, D. 2011. Reinforced Concrete Design, Tata McGraw Hill Education Private Limited, New Delhi
- 3. Kong, F.K., Evans, R.H. 1987. Reinforced and Pre-stressed Concrete, ELBS, London
- 4. Agrawal, P., Shrikhande, M. 2006. Earthquake Resistant Design of Structures, PHI Learning Private Limited, New Delhi (Reprint 2008)
- 5. Dayaratnam, P. Design of Reinforced Concrete Structures, Oxford and IBH Publishing Company

### Evaluation scheme:

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

Chapters	Hours	Marks distribution *
1	3	4
2	4	4
3	5	6
4	6	12
5/6/7	10	12
8	6	6
9	6	12
10	8	12
11	6	6
12	6	6
<b>Total</b>	<b>60</b>	<b>80</b>

\* There may be minor deviation in marks distribution.

## TRANSPORTATION ENGINEERING II CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1**

**Year : IV**  
**Part : I**

### **Course Objective:**

After the completion of the course, students will be able to design, construct, supervise, repair and maintain the roads. They will be familiar with the traffic design, control and operation. The course provides 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

**Tutorials:**

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

**Practicals:**

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

**References:**

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

**Evaluation Scheme:**

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

Chapter	Hours	Mark distribution*
1	16	28
2	8	16
3	10	20
4	6	8
5	5	8
Total	45	80

\* There may be minor deviation in marks distribution.

## HYDROPOWER ENGINEERING

CE ...

Lecture : 4  
Tutorial : 2  
Practical : 1

Year : IV  
Part : I

### Course Objectives:

The objective of this course is to make student acquainted with the hydropower development issues starting from the inception stage to the final design stage. After completion of this course, the students will be able to design independently various components of hydropower system with proper use of hydraulics. The course will also cover the hydro-mechanical equipments and electro-mechanical installations.

- 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. 4.2.7 Seepage Control and foundation treatment in Dams : Types of grouting and drainage and their necessity,
    - 4.2.8. 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-electric Machines [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]**

Powerhouse types, general arrangement, dimension of powerhouse

**Tutorials:**

- 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 dimension based on hydro-mechanical equipment designed in Ch. 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. Water Power Engineering, Dandekar and Sharma, VikasPublishin house, New Delhi
2. Hydraulic Structures, Novak, P. et al., Taylor and Francis, London
3. Water Power Development, Volume 1: Low-head Hydropower Plants, Mosonyi, E., Academia Kiado, Budapest
4. Water Power Development, Volume 2: High-head Hydropower Plants, Mosonyi, E., Academia Kiado, Budapest
5. Hydropower Engineering, Warnick CC et al., Prentice Hall, Inc, Englewood Cliffs, NJ
6. Irrigation Engineering and Hydraulic Structures, Garg ,SK, Khanna Publishers, New Delhi
7. Hydropower Development- Series (17 Volumes), Vol. 8, 9, 10, 12,13, 14, Norwegian Universty of Science and
8. Technology (NTNU), Norway
9. Irrigation Engineering and Hydraulic Structures, Garg ,SK, Khanna Publishers, 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.

Chapters	Hours	Marks Distributions *
1 and 2	4,6	10
3	6	12
4	18	24
5	10	12
6	8	12
7 and 8	6,2	10
Total	60	80

\* There may be minor deviation in marks distribution.

## ESTIMATING AND COSTING

CE ...

Lecture : 3

Tutorial : 1

Practical : 0

Year : IV

Part : I

### Course objective:

The objective of this course is to give the students basic knowledge of estimating and costing of civil engineering works. After completing this course the students will also be able 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 Estimates
  - 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 Frame Structured Building
  - 6.2. Detailed Estimate of a Two Roomed Load Bearing and Framed 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. Estimating, Costing, Specification and Valuation by M. Chakraborti
2. Text book of Estimating and Costing (Civil Engineering) by G.S. Berdie
3. Estimating and Costing by A.K. Upadhyaya.
4. Estimating and Project Management for small construction firms by Seymour Berger and Jules B. Godel

**Evaluation Scheme:**

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

Chapter	Hours	Mark Distribution*
1	3	5
2	5	10
3	3	5
4	9	20
5	5	5
6	20	35
Total	45	80

\* There may be minor deviation in marks distribution.

## PROJECT WORK – I CE ...

**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**

## BIO-ENGINEERING

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : I

### 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 bioengineering (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 bioengineering 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 bioengineering systems.**
  - 4.1. Evaluation of compatibility of civil and bioengineering systems.

**Not:** 15 hours in the field and 7.5 hours report presentation

**References:**

1. Biotechnical and soil bioengineering slope stabilization a practical guide for erosion control -Donald H. Gray, Robin B. Sotir
2. Use of vegetation in civil engineering – N.J.Coppin, I.G.Richards.
3. Soil erosion and conservation - R.P.C.Morgan
4. Roadside bioengineering: site handbook : Reference manual
5. Slope stabilization and erosion control: A bioengineering Approach - R.P.C.Morgan, R.J. Rickson

**Evaluation Scheme:**

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

Chapter	Hour	Marks Distribution *
1	4	8
2	10	16
3	4	8
4	6	8
5	4	8
6	6	8
7	4	8
8	2	4
9	4	8
10	1	4
Total	45	80

\* There may be minor deviation in marks distribution.

## ROCK ENGINEERING

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : I**

### 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

### Tutorials:

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

### Field Visit:

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

**(2 days)**



**References:**

1. Nilsen, B. and Thidemann, A. 1993. Rock Engineering. Norwegian University of Science and Technology, Trondheim, Norway, 156p.
2. Nilsen, B. and Palmstrom, A. 2000. Engineering Geology and Rock Engineering, Norwegian Group of Rock Mechanics (NBG), Norway, 249p.
3. Hoek, E. and Bray, J. W. 1981. Rock Slope Engineering. Institute of Mining and Metallurgy, London, 358p

**Evaluation scheme:**

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

Chapter	Hours	Marks Distributions*
1	1	0
2	4	8
3	6	12
4	4	8
5	6	12
6	6	12
7	4	12
8	2	4
9	10	8
10	2	4
Total	45	80

\* There may be minor deviation in marks distribution.

## EARTH HAZARD

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### 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, Mechanism and effect 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 designs., Geomorphological subdivision of the Himalayas, and their specific hazards, Introduction to 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 region, 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. (1990) Mountain Risk Engineering Handbook, Vol 1 and 2. ICIMOD, Kathmandu, Nepal 875pp.
2. YBDRO (1990) : Mitigating Natural Disaster: Phenomena Effect and Options, a Manual for Policy Makers and Planners, United Nations. New York, 164PP.
3. Terzaghi, K. Peck, R.B. (1967): Soil Mechanics in Engineering Practice, Second Edition. John Wiley and Sons Inc. 729pp.
4. Linsley, Kohler Penhus, Hydrology for Engineers. Mc. Graw-Hill.

5. Department of Roads (1996) Bioengineering for Road Engineer's Training Module Vol 1 and 2. DOR/HMG Nepal, 1227pp.
6. Brunsden Prior (Editors) 1984 Slope Instability

**Examination Scheme:**

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

Chapter	Hours	Marks Distributions <sup>+</sup>
1	4	8
2	8	12
3	7	12
4	4	8
5	10	20
6	12	20
Total	45	80

\* There may be minor deviation in marks distribution.

## STRUCTURAL DYNAMICS

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : I

### Course Objectives:

To understand the 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 cases where orthogonality conditions are not satisfied

### Tutorials/Practical:

1. Each of the students shall work on a number of individual assignments with problems following
2. the progress of the lectures. The assignments will be generally related with the application of
3. software packages, such as, Matlab, Mathematica and SAP 2000. All the assignments shall be
4. submitted within the prescribed time, and will be evaluated as the practical work.

**References:**

1. Clough R. W., Penzien J, **Dynamics of Structures**, 2nd edition: McGraw Hill 1993.
2. Chopra A. K., **Dynamics of Structures : Theory and Applications to Earthquake Engineering**, Prentice Hall, 2007.
3. Paz, M.,and Leigh, W., **Dynamics of Structures– Theory and Computation**, 5th Kluwer Academic Publishers,2004.edition,
4. Thompson, W. T., **Theory of Vibration with Applications**, Prentice-Hall, Fourth Edition, 1993.

**Evaluation Scheme:**

The questions shall cover contents of all the chapters of the syllabus as far as practicable, and the tentative marks distribution will be as follows:

Chapters	Hours	Marks Distribution *
1	4	4
2	12	24
3	14	28
4	7	12
5	8	12
Total	45	80 Marks

\* There may be minor deviation in marks distribution.

# SEISMIC RESISTANT DESIGN OF MASONRY STRUCTURES CE ...

Lecture : 3  
Tutorial : 1  
Practical 1.5

Year : IV  
Part : I

## Course Objectives:

After completion of the course, the students should be able

- 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 wall
4. Design of reinforced masonry wall (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, 1992.
2. W. Hendry, B. P. Sinha, S. R. Davies, Design of Masonry Structures. E & FN Spon, Londn UK, 1997
3. S. Sahlin. Structural Masonry. Prentice Hall, Englewood Cliffs, New Jersey, 1971.
4. W. Hendry. Structural Masonry. Macmillan, Houndmills, Basingstoke, 1998.
5. Tomazevic, M, 1999. 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 (1986/2010). Guidelines for earthquake resistant non-engineered construction.

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution *
1	8	16
2	4	8
3	5	10
4	12	20
5	10	16
6	6	10
Total	45	80

\* There may be minor deviation in marks distribution.

## TRAIL SUSPENSION BRIDGE

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : I**

### Course objectives

- Introduce trail suspension bridge
- Make capable to plan, analyze, 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 specification
    - 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 hrs
2. Design exercise on design of tower 4 hrs
3. Design exercise on tower foundation and cable anchorage 3 hrs

### Practical Works

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 organized. 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



**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution *
1	2	6
2	6	12
3	26	40
4	2	6
5	9	16
Total	45	80

\* There may be minor deviation in marks distribution.

## Transportation Planning and Engineering

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : I

### Course objective:

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

- 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

### Tutorials:

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

### 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 maximum 4 students per group) for the submission and subsequent presentation.

**References:**

1. Principles of Urban transportation planning, B.C. Hutchinson, McGraw Hill Publishing Company
2. Introduction to Transportation Engineering and Planning, E.K. Morlok, International Student Edition, McGraw Hill Publishing Company 1987
3. Urban Transportation planning. Michael D. Meyer & Eric J. Miller. McGraw Hill, 2002.
4. Airport Planning and Design, S. K. Khanna, M.G. Arora, S.S. Jain, Nem Chand and Bros. Roorkee, 2005
5. Principles of Railway Engineering, S.C. Rangwala, Charotar Publishing House Pvt. Ltd. India, 2010.
6. Transportation Engineering, Volume I and II, V.N. Vazirani and S.P. Chandola, Khanna Publishers, Delhi, India.
7. Technical Guidelines for Gravity Goods Ropeways, DoLIDAR, 2010.

**Evaluation scheme:**

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

Chapters	Hours	Marks Distribution *
1	6	8
2	4	8
3	8	16
4	2	4
5	10	16
6	10	16
7	5	12
Total	45	80

\* There may be minor deviation in marks distribution.

## ROPEWAY ENGINEERING

Lecture : 3

Tutorial : 1

II Practical

Year : IV

Part :

: 1.5

### Course objectives:

- Introduce ropeway transport, types of ropeway and their components.
- Make acquainted with the planning, analysis, design and construction of aerial and surface ropeway for passengers.
- Make capable to plan, analyze, 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 requirement and design provision
- 4.2. Wire-rope design
  - 4.2.1. Introduction to wire-ropes and their specification
  - 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. Non linear behavior of wire-rope, 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 equipments
- 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 measure

### Tutorial:

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

### Project works:

Design of a gravity ropeway system

### Field work:

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

**References:**

1. Technical guidelines for gravity goods ropeway; DoLIDAR, Ministry of Local Development
2. Ropeways in Nepal; Gyawali, D. & Dixit, A.
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 , Pergamon press, Oxford London
8. Cable stabilization for wind and moving load effect, M. Kazakevitch. Zakora" Journal of Wind Engineering and Industrial Aerodynamics (1998)

**Evaluation scheme:**

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

Chapter	Hours	Marks distribution *
1 & 2	5	6
3	5	8
4	20	40
5	2	6
6	9	14
7	4	6
Total	45	80

\* There may be minor deviation in marks distribution.

## SOIL CONSERVATION AND WATERSHED MANAGEMENT

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : I

### Course Objectives:

After the completion of the course, the students will be able to estimate the runoff and soil loss, design contour bunds, grassed waterways, terraces, drainage structures, gully control structures, small storage structures etc. & 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 method; 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 Farm Yard Manure (FYM); Use of Micro irrigation Methods
  - 4.4. Grassland Farming
  - 4.5. Agro-forestry
  - 4.6. Horticulture
5. Engineering Measures for conservation of agri 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-agri 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 & 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

**Tutorials:**

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

**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, 2004.

2. WATERSHED MANAGEMENT. Guidelines for Indian Conditions. E.M.  
TIDEMAN, Omega Scientific Publishers, New Delhi, 1996.
3. Soil and Water Conservation Engineering. R. Suresh, Standard Publishers  
Distributors, New Delhi, 1997

**Evaluation Scheme:**

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

Chapters	Hours	Marks distribution *
1	2	5
2	5	10
3	2	5
4	4	5
5	9	20
6	7	15
7	3	5
8	7	10
9	6	5
Total	45	80

\* There may be minor deviation in marks distribution.

## WATER AND WASTEWATER QUALITY ANALYSIS

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : I**

### Course Objective:

The objective of the course is aimed at teaching the students for field oriented water and wastewater sampling techniques, water quality analysis, and their utilization. The laboratory work is expected to make students capable of carrying out in-depth analysis of water quality.

- 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

### Tutorials:

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



**Project works:**

1. Laboratory works for determination of
  - 1.1. Physical parameters
  - 1.2. Chemical parameters
  - 1.3. Microbiological parametersof water and wastewater samples
2. Water quality standards and functional standards

**References:**

- Andrew D. Eaton, Lenore S. Clesceri, and Arnold E. Greenberg, "Standard methods for the examination of water and wastewater", 1995
- A.K. Deo, "Environmental chemistry"
- WHO Guidelines for drinking-water quality

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	2	6
2	6	8
3	12	14
4	12	20
5	10	20
6	3	12
Total	45	80

\* There may be minor deviation in marks distribution.

# SOLID WASTE MANAGEMENT

CE .....

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : I

## Course Objective:

The aim of this course is to provide with up-to-date knowledge regarding technological, organisational and legislative developments and practices of handling solid wastes. This course covers 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 waste transformation
- 3. Solid Waste Handling, Collection, Transfer and Transport [9 hours]**
  - 3.1. Waste Collection Planning
  - 3.2. Onsite 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 Siting 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

**Tutorials:**

1. Introduction [1 hrs]  
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 hrs]  
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 hrs]  
Computation of Vehicle Size, Container Size, Number Required, Location, Analysis of SCS, HCS,
4. Municipal Solid Waste Processing and Ultimate Disposal [4 hrs]  
Land Fill Design Step, Numerical of LF Design, Numerical On Gas and Leachate Generation. Triangular model of leachate computation
5. Resource Recovery [2 hrs]  
Numerical on Solid Waste Decomposition, Oxygen Requirement for Decomposition and Combustions.
6. Overview of Waste Management Practices in Nepal [2 hrs]  
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. Integrated Solid Waste Management, George Tchobanoglous, Kilarly Theisen, Samuel Vigil; McGraw-Hill Inc, International Edition, 1993
2. Environmental Engineering, Howard Peavy, Donald Rowe, George Tchobanoglous; McGraw Hill Inc, International Edition, 1985
3. Handbook of Solid Waste Management, Frank Kreeith; 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

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	4	7
2	7	13
3	9	16
4	13	22
5	10	16
6	2	6
Total	45	80

\* There may be minor deviation in marks distribution.

## COMMUNITY DEVELOPMENT AND PARTICIPATORY RURAL APPROACH CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical 1.5**

**Year : IV**  
**Part : I**

### Course Objectives:

Upon the completion of the course the students shall be 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.

### Tutorials:

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 works:**

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 (1997) whose reality counts? Putting the first last, intermediate technology publication, London.
2. Nelson, Nici and Susan Wright (1995), Power and Participatory Development, Theory and practice, Intermediate technology publication, London.
3. Reid, David (1995) Sustainable Development, An introduction of Guide, Earthscan Publication ltd. London.
4. Slocum, Rechel. et. al (eds) (1995) Power, process and Participation- Tool for change, Intermediate technology publication, London.
5. Baseline studies
6. Shrivastave, A. K., 2004, Nature Conservation, APH Publishing Corporation New Delhi.
7. Jones, S., 2004, Environment, Development and Rural Livelihood, Earthscan, London.
8. Climatology: Oliver and Hidmore, Prentice Hall, 2nd Edition.

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	10	15
2	15	25
3	10	15
4	10	25
Total	45	80

\* There may be minor deviation in marks distribution.

# COMPUTATIONAL TECHNIQUES IN CIVIL ENGINEERING

CE ...

Lecture : 3

Tutorial : 2

Practical : 0

Year : IV

Part : II

## Course Objective:

The knowledge of numerical solutions of various civil engineering problems is essential to the analysis and design of the structures. This course includes the fundamentals of computational techniques required for those problems which cannot be solved by manually and ordinary methods. It teaches the steps required to solve the equations using algorithms and computer programs.

### 1. Introduction (4 hours)

- 1.1. History of numerical computations of civil engineering problems
- 1.2. Brief description of solution techniques
  - 1.2.1. Finite element method
  - 1.2.2. Finite difference method
  - 1.2.3. Boundary element method
  - 1.2.4. Discrete element method
  - 1.2.5. Smoothed particle hydrodynamics
- 1.3. Review of programming methods: (C or FORTRAN or Matlab)

### 2. Solutions of linear equations

(6 hours)

- 2.1. System of linear equations
- 2.2. Banded matrices
- 2.3. Data storage and memory optimization
- 2.4. Conjugate gradient method
- 2.5. Fourier Integral
  - 2.5.1. Discrete Fourier Transform
  - 2.5.2. Fast Fourier Transform

### 3. Elasticity in solids

(6 hours)

- 3.1. Stress displacement relationship
- 3.2. Stress-strain (constitutive) relations
  - 3.2.1. 3D state of solid, Lamé constants
  - 3.2.2. Plane stress and plane strain condition
  - 3.2.3. Axi-symmetric stresses
- 3.3. Equilibrium equations

### 4. Finite element method

(14 hours)

- 4.1. Direct stiffness method

- 4.1.1. Stiffness matrices for bar, truss and beam element matrices
- 4.1.2. Transformation matrices for 2D and 3D cases and assembly
- 4.1.3. Example of a truss
- 4.2. Coordinate system - local, global, natural
- 4.3. Interpolation functions
  - 4.3.1. Pascal triangle
  - 4.3.2. Polynomial function
  - 4.3.3. Lagrangian element
  - 4.3.4. Hermite interpolation for beam element
  - 4.3.5. Serendipity element
- 4.4. Application in solid and frames
  - 4.4.1. Formulation of stiffness matrices for bars, truss, beams and area (triangle) elements
  - 4.4.2. Isoparametric formulation (linear displacement field only) – 2D triangle and quadrilateral
  - 4.4.3. Example of dam: Calculate stresses giving pressure loads using computer programs
  - 4.4.4. Example on wall: Calculate stresses giving vertical loads using computer programs
  - 4.4.5. Example on wall: Calculate stresses giving vertical loads using computer programs
- 4.5. General introduction to pre and post processing

### 5. Finite difference method

(7 hours)

- 5.1. Finite differences
- 5.2. Explicit scheme and Implicit Scheme
- 5.3. Governing equations of movement of fluid (Momentum and continuity equations)
- 5.4. Discretization of Kinematic wave Equation (linear and non linear)
- 5.5. Order of accuracy of the scheme and its applications
- 5.6. Numerical diffusion, dispersion and stability of scheme
- 5.7. Applications of the schemes in hydraulic channel routing
- 5.8. Implicit dynamic wave model
- 5.9. Finite difference scheme for Saint-Venant equations

### 6. Method of Characteristics

(4 hours)

- 6.1. Introduction
- 6.2. Characteristics
- 6.3. Initial and boundary conditions
- 6.4. Solution to unsteady flow in pipes

### 7. Simulation of Ground water flow

(4 hours)

- 7.1. Steady state flow nets and finite difference grid

- 7.2. Simulation of seepage under a dam
- 7.3. One dimensional Implicit Model
- 7.4. Application in river-Groundwater system

**Tutorials:**

There shall be related tutorials exercised in class and given as regular homework exercises.

- 1. Introduction (2hrs)**  
Theory, definition and concept type questions  
Practical: Home work to make programs in C or FORTRAN or Matlab languages
- 2. Solutions of linear equations (6hrs)**  
Theory, definition and concept type questions  
Practical examples, and numerical examples types questions  
Write algorithm and computer programs to solve the problems
- 3. Elasticity in solid (2hrs)**  
Theory, definition and concept type questions  
Practical examples of various conditions of stresses
- 4. Finite element method (FEM) (10hrs)**  
Theory, definition and concept type questions  
Practical examples, numerical examples and derivation type questions  
Analyze beams and simple frames
- 5. Finite difference method (4 hours)**  
Theory, definition and concept type questions,  
Practical examples, numerical examples and derivation type questions,  
exercercises on Hydraulic channel routing
- 6. Method of Characteristics (2 hours)**  
Theory, definition and concept type questions, Solution of unsteady flow
- 7. Simulation of Ground water flow (4 hours)**  
Theory, definition and concept type questions ,exercercises on Seepage under dam and River stage –Water table evaluation

**Assignments**

- 1. Analyze a 2D dam to find stresses giving water pressure and surcharge
- 2. Analyze a 2D wall panel to find stresses giving vertical loads
- 3. Analyze 2 storey 2 bay frame and draw bending moments and shear force diagrams
- 4. Write source codes to solve Saint-Venant equationsmarks distribution.

**References:**

- 1 P. Karasudhi, Foundation of Solid Mechanics, Kluwer Acedemic Publishers, 1991.
- 2 O. C. Zienkiewicz, R. L. Taylor, Finite Element for Structural, Vol. 1, 2 & 3, Elsevier, 2000.
- 3 D. V. Huttan, Fundamentals of Finite Element Analysis, TATA McGRAW-HILL, 2004.
- 4 T. R. Chandrapatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI, 2000.
- 5 W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second Edition, Cambridge University Press.
- 6 W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, Numerical Recipes in Fortran, The Art of Scientific Computing, Second Edition, Cambridge University Press.
- 7 Ralph A. Wurbs, Wesley p.James, Water Resources Engineering, Prentice-Hall India.
- 8 M. HanifChaudhry, Open Channel Flow, Prentice-Hall India.
- 9 VenTe Chow, D.R. Maidment, L.W. Mays, Applied Hydrology, McGraw-Hill

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution*
1	4	8
2	6	8
3	6	10
4	14	16
5	7	12
6	4	8
7	4	8
Total	45	80

\* There may be minor deviation in marks distribution.

## ENGINEERING PROFESSIONAL PRACTICE

CE .....

Lecture : 2

Tutorial : 0

Practical : 0

Year : IV

Part : II

### Course Objective:

To familiarize the students with their roles in the society, ethical and legal environment in which engineering is practiced, contract administration, regulatory environment and contemporary issues in Engineering.

1. **History of Engineering Practices** [3 hours]
  - 1.1. Man and Society
  - 1.2. Technology and Society
  - 1.3. History of Engineering Practice in Eastern Society
  - 1.4. History of Engineering Practice in Western society
  - 1.5. Engineering Practices in Nepal
2. **Profession and Ethics** [6 hours]
  - 2.1. Profession: Definition and Characteristics
  - 2.2. Professional Institutions
  - 2.3. Relation of an Engineer with Client, Contractor and Fellow Engineers
  - 2.4. Ethics, Code of Ethics and Engineering Ethics
  - 2.5. Moral Dilemma and Ethical Decision Making
  - 2.6. Detailed Duties of an Engineer and Architect
  - 2.7. Liability and Negligence
3. **Professional Practices in Nepal** [3 hours]
  - 3.1. Public Sector practices
  - 3.2. Private Sector Practices
  - 3.3. General Job Descriptions of Fresh Graduates in both Public and Private Sector
4. **Contract Management** [6 hours]
  - 4.1. Methods of work execution/contracting
  - 4.2. Types of Contracts
  - 4.3. Tendering Procedure
  - 4.4. Contract agreement
5. **Regulatory Environment** [5 hours]
  - 5.1. Nepal Engineering Council Act

- 5.2. Labor Law
- 5.3. Intellectual Property Right
- 5.4. Building Codes and Bylaws
- 5.5. Company Registration

6. **Contemporary Issues in Engineering** [3 hours]
  - 6.1. Globalization and Cross Cultural Issues
  - 6.2. Public Private Partnership
  - 6.3. Safety, Risk and Benefit Analysis
  - 6.4. Development and Environment
  - 6.5. Conflict and Dispute Management
7. **Case Studies based on Engineering Practices** [4 hours]

### References:

1. Carson Morrison and Philip Hughes "Professional engineering Practice – Ethical Aspects", McGraw-Hill Ryerson Ltd.' Toronto 1982
2. DrRajendraAdhikari, "Engineering Professional Practice – Nepalese and international Perspectives" Pashupati Publishing House, Kathmandu Nepal 2010
3. M. Govindarajan; S Natarajan and V.S. Senthikumar., " Engineering Ethics" – PHI Learning Pvt. Ltd. New Delhi 2009
4. Nepal Engineering Council Act
5. Contract Act
6. Labor Act
7. Company Act
8. Copyright Act
9. Public Procurement Act
10. Building By-Laws



**Evaluation Scheme:**

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

Chapter	Hours	Marks distribution *
1	3	4
2	6	8
3	3	4
4	6	8
5	5	6
6	3	4
7	4	6
Total	30	40

\* There may be minor deviation in marks distribution.

# TECHNOLOGY ENVIRONMENT AND SOCIETY

CE ..

**Lectures : 2**

**Tutorials : 0**

**Practical : 0**

## **Course Objectives:**

The course has been devised to provide knowledge of environment, technology and its impact on society. It would be helpful to the students to understand the global, national and local environmental issues and challenges of the information society.

### **1. Technology (8hours)**

- 1.1. Definition,
- 1.2. Impact of technology on environment & society,
- 1.3. Benefits of technology due to new inventions,
- 1.4. Conflict of technology, technology creates opportunity for society to change
- 1.5. Appropriate technology,
- 1.6. Intermediate technology, labor based and labor intensive technology,
- 1.7. Shifts in employment due to technological advancement,
- 1.8. Role of technology to unmask old social problems, society's control of technology,
- 1.9. Impact of technology on culture, tradition and social values,
- 1.10. Technology is irreversible,
- 1.11. Agricultural age, industrial age and information age,
- 1.12. Characteristics of information society,
- 1.13. Information as power and wealth

### **2. Development approach: (6 hours)**

- 2.1. LEP (labor based, environment friendly and participatory),
- 2.2. Community management, engineers role as facilitator,
- 2.3. Key features of infrastructure development policies of Nepal,
- 2.4. Ethnographic approach to collect information ,
- 2.5. Participatory approach as community empowerment ,
- 2.6. Participatory tools, focus group discussions, key informants interview,
- 2.7. Participatory observation, structured questionnaire,
- 2.8. Resource mapping, wealth ranking, poverty definition

### **3. Brief history of human civilization (4 hours)**

- 3.1. Early civilization,
- 3.2. Great renaissance of Europe,

- 3.3. Early part of industrial revolution,
- 3.4. Transformation of industrial society into information society,
- 3.5. Impact of world war 1 & 2, Population explosion,
- 3.6. Rise of environmental issues,
- 3.7. Climate change as a threat to human civilization

### **4. Environment (3 hours)**

- 4.1. Definition,
- 4.2. Importance, ecology & ecosystem,
- 4.3. Conservation of environment,
- 4.4. Optimum utilization of natural resources,
- 4.5. Renewable and non renewable resources,
- 4.6. Conflict of resources,
- 4.7. Global environmental issues,
- 4.8. Environmental issues of Nepal

### **5. Water and air pollution (6 hours)**

- 5.1. Fecal -oral infection transmission route
- 5.2. Preventive measures,
- 5.3. On site sanitation(including eco -sanitation),
- 5.4. Importance of health education,
- 5.5. Organic pollution,
- 5.6. Inorganic pollution( nitrate, fluoride, iron, manganese, calcium arsenic, heavy metals), water pollution due to insecticides and pesticides
- 5.7. Sources, causes& impacts of airpollution
- 5.8. Mitigation measures,
- 5.9. Indoor air pollution,
- 5.10. Severity of its problems in Nepal

### **6. Climate change (3 hours)**

- 6.1. Definition, causes, impacts,
- 6.2. Mitigation measures,
- 6.3. International efforts to mitigate its problems,
- 6.4. Bio –gas, organic farming,
- 6.5. Deforestation and its consequences,
- 6.6. Importance of national parks, conservation areas and forestation programs in Nepal

**References:**

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Environmental Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
2. H.G. Wells, "Brief History of Civilization"
3. J. Neharu, "Glimps of World History"

**Examination scheme**

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

Chapters	Hours	Marks Distribution *
1	8	10
2	6	8
3	4	4
4	3	4
5	6	10
6	3	4
Total	30	40

\* There may be minor deviation in marks distribution.

## CONSTRUCTION MANAGEMENT

CE ...

Lecture : 4

Tutorial : 2

Practical : 0

Year : IV

Part : II

### Course Objective:

- To provide basic knowledge on management of construction works
- To make able to plan and schedule of resources required in construction project.
- To provide basic knowledge of procurement/contract management
- To make able to monitor and evaluate construction projects.
- To provide basic knowledge on maintenance, specification and valuation.

- 1. Construction Management Framework [3 hours]**
  - 1.1. Construction Landmarks
  - 1.2. Scope of Construction Management
  - 1.3. Construction Project Characteristics.
  - 1.4. Construction Project Life Cycle Phases.
  - 1.5. Construction Project Management.
  - 1.6. Relation between Client, Consultant and Contractor
- 2. Construction Planning and Scheduling [5 hours]**
  - 2.1. Construction Planning – Introduction
  - 2.2. Steps and Stages of Planning
  - 2.3. Planning by Contractor and Clients in Different Stages
  - 2.4. Preparing Schedule
  - 2.5. Time Cost Trade Off
- 3. Planning Construction Material. [5 hours]**
  - 3.1. ABC Classification of Construction Materials
  - 3.2. Material Wastage Standards.
  - 3.3. Material Provisioning Process
  - 3.4. Material Inventory Basics
  - 3.5. Inventory Planning Process
  - 3.6. Application Of Value Engineering in the Procurement of Materials
- 4. Familiarization with Construction Equipments [7 hours]**
  - 4.1. Advantages and Disadvantages of using Equipments.
  - 4.2. Equipments for Excavation, Transporting and Compaction; Aggregate Production and Handling; Concrete Construction; Cranes for Lifting;

Tunnel Construction; Highway and Pavement Construction; Hydraulic Structure Construction

4.3. Selection of Appropriate Equipment

- 5. Contract Management [6 hours]**
  - 5.1. Method of Work execution
  - 5.2. Types of Contract
  - 5.3. Tendering Process – Preparation before Tendering; Tender Notice; Tender Document; Conditions of Contract; Prequalification; Tender; Evaluation; Selection and Award
- 6. Construction Process [3 hours]**
  - 6.1. Site Surveying and Preparation
  - 6.2. Arrangement of Facilities and Shops/ Job Layout
  - 6.3. Material Handling System
  - 6.4. Financial Management and Cash flow Management
- 7. Controlling Project Integration and Work [5 hours]**
  - 7.1. Work Scope Control
  - 7.2. Product Quality Control
  - 7.3. Labor Productivity Control
  - 7.4. Equipment Productivity Control
  - 7.5. Material Productivity Control
  - 7.6. Work Schedule Control
  - 7.7. Performance Control Using Earned Value Analysis
- 8. Site Management [3 hours]**
  - 8.1. Responsibility of Site Engineer
  - 8.2. Supervising Work of Contractor
  - 8.3. Record Keeping
  - 8.4. Site Order Book
  - 8.5. Procedures to Prepare Bills
  - 8.6. Measurement Book
  - 8.7. Muster Roll
- 9. Project Maintenance [4 hours]**
  - 9.1. Maintenance Basics
  - 9.2. Types of Maintenance
  - 9.3. Planning and Scheduling of Maintenance
  - 9.4. Estimating Maintenance Cost
  - 9.5. Management of Maintenance and Financing

**10. Personnel Management [4 hours]**

- 10.1. Management principles: Administration and Organization principles
- 10.2. Centralization and Decentralization
- 10.3. Supervisory and Leadership styles
- 10.4. Importance of communication
- 10.5. Information System for decisions
- 10.6. Motivating and directing: human elements, evaluation and merit ranking
- 10.7. Personnel selection, testing and training
- 10.8. Trade unions and relation with management

**11. Regulatory Requirements [2 hours]**

- 11.1. Safety Requirements
- 11.2. Workman's compensation board
- 11.3. Fire regulations and Insurance
- 11.4. Environment concern and protection
- 11.5. Building codes and quality control.

**12. Specification [6 hours]**

- 12.1. Purpose of Specifications
- 12.2. Types of Specifications: General and Detailed Specifications
- 12.3. Specification Writing: technique, use of international and local Standards, Codes of Practice
- 12.4. Importance of Specifications

**13. Valuation [7 hours]**

- 13.1. Introduction
- 13.2. Cost and Value
- 13.3. Purpose of Valuation and Principle of Valuation
- 13.4. Factors affecting the Value of the Property
- 13.5. Value Classification
- 13.6. Sinking Fund
- 13.7. Capitalized value
- 13.8. Obsolescence
- 13.9. Depreciations
- 13.10. Qualification of a Valuer
- 13.11. Valuation of Land
- 13.12. Various Methods of valuation of Properties
- 13.13. Role of Computers in Valuation.
- 13.14. Report Writing

**Tutorials:**

- 1. Time Cost Trade off [2 hours]
- 2. ABC Classification of Materials [2 hours]
- 3. Job Layout exercise [1hour]
- 4. Earned Value analysis [3 hours]
- 5. Writing Specification [3 hours]
- 6. Valuation [4 hours]

**Field visit of construction site – 2 days.**

**References:**

- 1. Chitkara, K. K, Construction Project Management; McGraw Hill.
- 2. Gupta, B.L, Gupta, Amit; Construction Management and Machinery; Standard Publishers Distributors
- 3. Peurifoy, R L. Construction Planning, Equipment and Methods, McGraw Hill.
- 4. Harris, Frank , Construction Plant Excavating and Materials handling equipment and Methods, Granada Publishing, London
- 5. Adhikari, R. P. , Construction Management
- 6. G S Birdie, Estimating, Valuation and Specifications

**Evaluation Scheme:**

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

Chapter	Hours	Mark Distribution *
1	3	5
2	5	8
3	5	6
4	7	12
5	6	8
6	3	3
7	5	4
8	3	4
9	4	8
10	4	8
11	2	2
12	6	6
13	7	6
Total	60	80

\* There may be minor deviation in marks distribution.

## PROJECT WORK II CE ...

supervisor can correct the mistakes. The final report should be submitted to the Department Head in duplicate.

**Lecture : 0**  
**Tutorial : 0**  
**Practical : 6**

**Year : IV**  
**Part : II**

### **Course Objective:**

Project Work II is the continuation of Project Work –I. In Project-II students are required to complete following works in carry-over of project –I falling under different categories of project works:

1. Design type project
  - 1.1. Design of the system and their alternatives
  - 1.2. Detail drawings
  - 1.3. Cost Estimation
  - 1.4. Economic and financial analysis
  - 1.5. References
2. Dissertation type project
  - 2.1. Model Formulation
  - 2.2. Model application
  - 2.3. Results and discussions
  - 2.4. Larger Implications
  - 2.5. Conclusion and recommendations
  - 2.6. References
3. Experimental type project
  - 3.1. Formulation of hypotheses or model
  - 3.2. Analysis of results and model application
  - 3.3. Results and discussions
  - 3.4. Larger Implications
  - 3.5. Conclusion and recommendations
  - 3.6. References

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 should then compile project work –I and project work II write ups and submit a draft report prior to the final report so that the

## **Elective II**

## WATER QUALITY MANAGEMENT CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### Course Objectives:

Upon the completion of the course the students shall be able to understand the importance of aquatic ecology, water pollution, water quality standards, water quality assessment and its management.

- 1. Introduction: (2 hours)**
  - 1.1. Water resources and its usage including livelihood
  - 1.2. Water cycle and water budget,
  - 1.3. Fresh water
  - 1.4. Competitive uses of water.
- 2. Aquatic Ecology: (4 hours)**
  - 2.1. Ecology and eco-system
  - 2.2. River and lake ecology,
  - 2.3. Stratification and structure of water masses,
  - 2.4. Aquatic plants and animals.
- 3. Water Pollution: (6 hours)**
  - 3.1. Types and sources of water pollution,
  - 3.2. Point and non-point pollution sources,
  - 3.3. Effects of pollution (river, lake and reservoir),
  - 3.4. Pollution of ground water
- 4. Water Quality Standards: (14 hours)**
  - 4.1. Domestic (drinking, cooking bathing and washing , watering of lawns and gardens, heating and air condition system)
  - 4.2. Agriculture
  - 4.3. Street washing
  - 4.4. Fire fighting
  - 4.5. Swimming pools , fountains and cascade
  - 4.6. Steam power and other industrial process
  - 4.7. Commercial
  - 4.8. Public use: parks, street washing, sewer cleaning
  - 4.9. Developing animal husbandry
  - 4.10. Transporting sewage

- 4.11. Recreation
- 4.12. Various uses of water maintaining ecological balance.

- 5. Water Quality Assessment: (14 hours)**
  - 5.1. Waste loads and assimilative capacity of receiving waters (surface and ground)
  - 5.2. River water quality, stream flow
  - 5.3. DO sag curve, its model and application
  - 5.4. Lake water quality
  - 5.5. Eutrophication control,
  - 5.6. Ground-water contamination and its movement,
  - 5.7. Ground water plumes.
- 6. Management: (5 hours)**
  - 6.1. Strategies for water pollution control.
  - 6.2. Water quality monitoring, management planning, and
  - 6.3. River catchment management.

### Tutorials:

1. Introduction (1 hour)  
Definitions, water cycle , schematic diagrams of water cycle,
2. Aquatic ecology (1 hour)  
Definitions, point and non-point pollution sources, effects of pollution (river, lakes and reservoir),
3. Water pollution: (2 hours)
  - 3.1. Definition, point and non-point pollution levels in river, lakes and reservoir and its effects,
  - 3.2. Level of pollution of ground water at various places
4. Water quality standards: (4 hours)  
Definitions, WHO guidelines and national standards for various purposes.
5. Water quality assessment: (4 hours)
  - 5.1. Definitions, plotting DO sag curve and its model application for river and lake.
  - 5.2. Ground water pollution and its movement
6. Management: (3 hours)
  - 6.1. Development of strategies for water pollution control.
  - 6.2. Checklist making for water quality monitoring, management

### Practical / Project works:



1. Point and non-point pollution sources
2. Water Quality Standards and functional standards
3. Determination of DO Sag curve
4. Surface/ground-water and contamination and its movement
5. Water quality monitoring and management

**Referees:**

- Andrew D. Eaton, Lenore S. Clesceri, and Arnold E. Greenberg, "Standard methods for the examination of water and wastewater", 1995
- A.K. Deo, "Environmental chemistry"
- C. S. Rao, Environmental pollution control Engineering", Wiley eastern ltd., 1995
- Robert V. Thomann, John A. Mueller, " Principles of Surface quality modeling and control"
- WHO Guidelines for Drinking-water Quality

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	2	6
2	4	8
3	6	14
4	14	20
5	14	20
6	5	12
Total	45	80

\* There may be minor deviation in marks distribution.

**DOMESTIC WATER&WASTE WATER ENGINEERING AND  
MANAGEMENT  
CE ...**

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

**Course Objectives:**

Upon the completion of the course the students shall be able to understand the importance of domestic water and wastewater management, household tank capacity design, water treatment for domestic use and waste water management.

- 1. Introduction: (4 hours)**
  - 1.1. Water sources and use of water in domestic purposes, domestic (drinking, cooking bathing, washing , watering of lawns and gardens, heating and air condition systems)
  - 1.2. Impact of using polluted and contaminated water in domestic use,
  - 1.3. Existing scenario on polluted and contaminated water.
  - 1.4. Wastewater quantity and disposal
- 2. Quantity and source selection: (4 hours)**
  - 2.1. Quantity determination
  - 2.2. Source selection- supplied water, ground water, rainwater harvesting
  - 2.3. Determination of household tank capacity,
  - 2.4. Use of separate tanks for different purpose
- 3. Quality of water for domestic use: (8 hours)**
  - 3.1. Types and sources of water pollution,
  - 3.2. Point and non-point pollution locations,
  - 3.3. Effects of pollution
  - 3.4. River water quantity and collection
  - 3.5. Water sampling and examination of water
- 4. Treatment : (16 hours)**
  - 4.1. Screening
  - 4.2. Aeration including protection works
  - 4.3. Plain sedimentation
  - 4.4. Sedimentation with coagulation
  - 4.5. Filtration

- 4.6. Disinfection
- 4.7. Other chemical treatments
- 4.8. Storage system

- 5. Wastewater: (10 hours)**
  - 5.1. Wastewater quantity -grey water, black water, yellow water, rain water and sanitary sewage
  - 5.2. Collection and use of wastewater in domestic use
  - 5.3. Laboratory analysis of water and wastewater sample BOD, COD, TS, VSS and FS
  - 5.4. Wastewater treatment
  - 5.5. Components: traps, manholes, grit and grease chamber
  - 5.6. Constructed wetland
  - 5.7. Reed bed treatment (horizontal and vertical)
  - 5.8. Vent pipe
  - 5.9. Septic tank and soak pit
- 6. Solid waste management (3 hours)**
  - 6.1. Quantity generated and characteristics
  - 6.2. Segregation
  - 6.3. Composting and incineration
  - 6.4. Use of waste as fertilizer within household
  - 6.5. Biogas

**Tutorials:**

1. Introduction (1 hour)  
Definition, water in domestic purpose, existing scenario on polluted and contaminated water.
2. Quantity and source selection (2 hours)
  - 2.1. Quantity determination - supplied water, ground water, rainwater harvesting
  - 2.2. Numerical on determination of household tank capacity,
  - 2.3. Use of separate tanks for different purpose
3. Quality of water for domestic use : (2 hours)
  - 3.1. Definition
  - 3.2. Level of pollution of ground water at various places
  - 3.3. Water sampling and examination of water
4. Treatment : (5 hours)  
Design on screening, aeration, and its protection works, plain sedimentation, sedimentation with coagulation, filtration, disinfection and other chemical treatments, storage system.

5. Wastewater: (4 hours)
  - 5.1. Determination of grey water, black water, yellow water, rain water and sanitary sewage,
  - 5.2. Collection and use of wastewater in domestic use
  - 5.3. BOD, COD, TS, VSS and FS laboratory analysis
  - 5.4. Design of traps, manholes, grit and grease chamber
  - 5.5. Design of constructed wetland
  - 5.6. Design of reed bed treatment
6. Solid waste management: (1 hour)
  - 6.1. Design of composting and incineration
  - 6.2. Design of biogas

**Practical / Project works:**

1. Small scale household treatment plant
2. Reed bed treatment
3. Septic tank and soak pit
4. Constructed wetland
5. Compost plant

**References:**

1. Walter J. Webber Jr, Wiely-Interscience "Physicochemical Processes For Water Quality Control".
2. Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment", Prentice-Hall Inc..
3. Metcalf & Eddy , "Wastewater Engineering Treatment and Reuse", Inc, McGraw Hill.
4. Crites and Tchobanoglous, "Small and Decentralized Wastewater Management Systems", McGraw Hill.
5. S.R. Qasim, E.M.Motley and G. Zhu, "Water Works Engineering Planning, Design & Operation", Prentice-Hall.
6. A.P. Sincero and G.A. Sincero, "Environmental Engineering", Prentice-Hall.
7. Soli J Arceivala, 2003, 'Waste water treatment for pollution control', Tata McGraw-Hill publishing company Limited.
8. Larry D. Benefield and Clifford W. Randall, "Biological Process Design for Wastewater Treatment", Prentice-Hall Inc..
9. George Tchobanoglous, Hilary Theisen, Samuel A. Vigil Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw-Hill International Editions
10. WHO Guidelines for drinking-water quality

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	4	4
2	4	8
3	8	12
4	16	24
5	10	20
6	3	12
Total	45	80

\* There may be minor deviation in marks distribution.

## POST DISASTER WATER AND SANITATION MANAGEMENT

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

To give students a comprehensive theoretical and practical knowledge of WatSan and hygiene promotion in the different phases of emergencies, including disease prevention and preparedness. By the end of the course the students shall be able to assess and priorities WatSan needs for a population in the emergency with foresight, and to take appropriate measures to prevent and control disease outbreak.

### 1. Introduction: (10 hours)

- 1.1. Types of disasters and their consequences;
- 1.2. Different stages in emergency
- 1.3. International legal system and guidelines regarding refugees and internally displaced persons,
- 1.4. Concepts and tools for initial situation analysis and other rapid participatory assessment approaches,
- 1.5. Introduction of sphere handbook
- 1.6. The local cultural, religious and socio-economic contexts influencing perceptions of water, sanitation and hygiene

### 2. Health and diseases transmission in emergency settings (5 hours)

- 2.1. Identify relevant water, sanitation, personal hygiene, food hygiene and housing related diseases such as diarrhoea, malaria, hepatitis etc.,
- 2.2. Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic, consideration to classical threats in emergencies: thirst, hunger, trauma, heat and cold;
- 2.3. Design of hygiene campaigns

### 3. Technical aspects of WatSan: (14 hours)

- 3.1. Assess emergency water sources(surface water, ground and rainwater), their utilization, protection and disinfection;
- 3.2. Importance of sanitation and cleaning,
- 3.3. Disinfecting and construction of: wells, springs and pipe water schemes as well as water storage both in camps and within the household;
- 3.4. Practical knowledge of emergency sanitation (excreta, wastewater and solid waste), construction and maintenance of different latrines,

disposal and treatment systems, hygienic handling of animal corpses, ethically and culturally appropriate disposal of human corpses.

### 4. Hand on experience: (6 hours)

- 4.1. Apply practical experience on how to construct a latrine, installation and maintenance of a pump and chlorination of water supply
- 4.2. Emergency water filtration and disinfection

### 5. Post emergency and rehabilitation: (10 hours)

- 5.1. Analyze whether Watsan strategies employed in emergency phase are sustainable in the post-emergency phase.
- 5.2. Risk assessment of mitigation strategies
- 5.3. Monitoring and evaluation

### Tutorials:

1. Introduction (1 hour)  
Concept and tools for initial situation analysis and other rapid participatory assessment approaches
2. Health and diseases transmission in emergency settings: (2 hours)  
Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic, Design of hygiene campaigns
3. Technical aspects of WatSan: (4 hours)  
Disinfecting and construction of: wells, springs and pipe water schemes as well as water storage both in camps and within the household;
4. Hand on experience: (4 hours)  
Design for construction of a latrine, installation and maintenance of a pump and chlorination of water supply.
5. Post emergency and rehabilitation: (3 hours)  
Risk assessments of mitigation strategies

### Practical / Project works:

1. Concept and tools for initial situation analysis and other rapid participatory assessment
2. Identify prevention and control strategies, including surveillance of disease outbreak, and epidemic
3. Analyze Wat-san strategies employed in emergency phase
4. Risk assessment of mitigation strategies

**References:**

1. Wisner, B. and Adams, J. 2002. Environmental health in emergencies and disaster. WHO
2. Alexander, D. 2002. Principles of Emergency Planning and Management. Harpenden: Terra Publishing.
3. Davis, J., Lambert, R. 2002. Engineering in emergencies. A practical guide for relief workers, 2nd edition. ITDG Publisher.
4. Del Porto, D., Steinfeld, C., 2000. The composting toilet system: a practical guide to choosing, planning and maintaining composting toilet systems, an alternative to sewer and septic systems. The center for ecological pollution prevention (CEPP), Massachusetts
5. Wisner, B., Blaikie, P., Cannon, T., Davis, I. 2004. At Risk-Natural Hazards, People's Vulnerability and Disaster. Wiltshire Routledge

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	10	12
2	5	6
3	14	28
4	6	10
5	10	24
Total	45	80

\* There may be minor deviation in marks distribution.

## PUBLIC HEALTH AND RISK ASSESSMENT

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

This course broadens and deepens the concept of epidemiological studies and methodology, with a focus on environmental transmission. The students will work on cases related to diarrhoeal, parasitic and vector-borne diseases. The students will learn and be able to apply the Quantitative Microbial Risk Assessment (QMRA) concept. The students will be able to apply their knowledge in field projects as well as in system based management applications

### 1. Fundamentals of epidemiology (5 hours)

- 1.1. Infectious and noninfectious diseases
- 1.2. Infectious disease transmission routes
- 1.3. Organic and inorganic contaminants
- 1.4. Health and water quality

### 2. Pathogens (excreta bacteria, viruses protozoa, helminthes) and their control (10 hours)

- 2.1. Disease transmitted by arthropod vectors
  - 2.1.1. mosquito
  - 2.1.2. flies
  - 2.1.3. cockroaches
  - 2.1.4. ticks
  - 2.1.5. lice
  - 2.1.6. fleas
  - 2.1.7. rodents
  - 2.1.8. disease transmission mechanism and control
- 2.2. Water – related,
- 2.3. Excreta related
- 2.4. Refuse- related,
- 2.5. Housing –related,
- 2.6. Air-related diseases
- 2.7. Control HIV/AIDS.

### 3. Sample and questionnaire (8 hours)

- 3.1. Questionnaire based approaches,
- 3.2. Statistical handling and link to GIS based approaches
- 3.3. Surveys both in societies and in agricultural applications

### 4. Risk Assessment (2 hours) (8 hours)

- 4.1. Risk Assessment within an integrated system approach.
- 4.2. Quantitative microbial risk assessment (QMRA)
- 4.3. QMRA relate to risk reduction,
- 4.4. Treatment barriers, non-technical barriers.
- 4.5. Relationship to habits,
- 4.6. Handling practices

### 5. Relationship between public health and the risk assessment parts with the WHO guidelines for (8 hours)

- 5.1. Water,
- 5.2. Wastewater
- 5.3. Water safety plan to avoid fecal contamination.

### 6. Case studies (6 hours)

Case studies based on public health and the risk assessment

### Tutorials:

1. Introduction of epidemiology (2 hours)
2. Disease transmitted by arthropod vectors (2 hours)
3. Risk Assessment within an integrated system approach. Quantitative microbial risk assessment (QMRA) (7 hours)
4. Case studies (4 hours)

### Practical / Project works:

1. Concepts of epidemiology
2. Disease transmitted by arthropod vectors
3. Risk Assessment
4. Case studies

**References:**

1. Bennett, P., Calman, K. 2001. Risk Communication and Public Health, Oxford Medical Publications, London.
2. Fjeld, R. A., Eisenberg, N. A., Compton, K. L. 2007. Quantitative Environmental Risk Analysis for Human Health. John Wiley & Sons, NJ.
3. Lawson, A. B., Biggeri, A., Bohning, D., Lesaffre, E. 1999. Disease Mapping and Risk Assessment for Public Health, John Wiley & Sons, England.
4. Robson, M. G., Toscano, W. A. 2007. Risk Assessment for Environmental Health (Public Health/Environmental Health). Association of Schools of Public Health, John Wiley & Sons, San Francisco.
5. Andy Cairncross and Richard G. Feachem, Environmental Health Engineering in the Tropics, second edition, 1993.
6. Christopher R. Schulz and Danial A. Okun, "Surface Water Treatment for Communities in Developing Countries", 1984.
7. City for Copenhagen, healthy city plan, 1994-1997 Copenhagen, Copenhagen Health Services, 1994 (ISBN 8798411187)
8. JICA, July 1991, Basic design study report on "The Project for Kathmandu Water Supply Facility Improvement in The Kingdom of Nepal"
9. Richard G. Feachem, David j. Bradley, HemdaGarelick and D. Duncan Mara, "Appropriate Technology for Water Supply and Sanitation", health aspects of excreta and sullage management- a state of art review, the world bank , June 1981.
10. RWSSFDB, 2002, A study on "Water Quality", Rural Water Supply and Sanitation Fund Development Board.
11. Tsouros, A., ed WHO healthy cities projects: a project becomes a movement (review of progress 1987 to 1990) Copenhagen, WHO/FADL.1990 and SOGESS, Milan.
12. WHO Guidelines for Drinking-water Quality.

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	10	16
2	15	24
3	8	15
4	8	15
5	4	10
Total	45	80

\* There may be minor deviation in marks distribution.

## CLIMATE CHANGE

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### Course Objectives:

This course broadens the knowledge on fundamentals of climate change with respect to climate change science; and its causes, effects and uncertainties about climate change. It broadens the idea on technology, technological options for mitigating climate change, adaptation measures, risk analysis, economics, policy options and their impact on outcomes

### 1. Climate change science (10 hours)

- 1.1. Introduction to climate change science
  - 1.1.1. Radiation balance, atmospheric and ocean circulations. Historic climate change, El Nino.
  - 1.1.2. Feedback effects, impacts of land use, albedo, clouds, ocean storage of CO<sub>2</sub>.
  - 1.1.3. GHGs and energy use, inventory of GHGs, the carbon cycle.
  - 1.1.4. Natural and anthropogenic actors
- 1.2. Key indicators of global climate change and evidence
  - 1.2.1. Carbon dioxide concentration
  - 1.2.2. Global surface temperature
  - 1.2.3. Arctic sea ice
  - 1.2.4. Land ice
  - 1.2.5. Sea level
- 1.3. Causes
  - 1.3.1. Effect of greenhouse gases: greenhouse gases, consequences of change in natural greenhouse gases,
  - 1.3.2. The role of human activities: industrialization, combustion of fossil fuels, deforestation, forest fires, agricultural farming.
  - 1.3.3. Solar irradiance: sun is the driver of climate system in Earth, role of solar radiance in climate change
- 1.4. Effects/impacts
  - 1.4.1. More frequent wildfires,
  - 1.4.2. Air pollution
  - 1.4.3. Longer periods of drought in some regions
  - 1.4.4. Extreme weather
  - 1.4.5. Deforestation
  - 1.4.6. Agriculture change

- 1.4.7. Ecosystem and biodiversity
  - 1.4.8. Economic effects
  - 1.4.9. Diseases
  - 1.4.10. Water scarcity
- 1.5. Uncertainties about climate change
    - 1.5.1. Forcings: Solar irradiance, Aerosols, dust, smoke, and carbon particles
    - 1.5.2. Feedbacks: cloud, carbon cycle, ocean circulation, precipitation, sea-level rise,

### 2. Technology (15 hours)

- 2.1. Role of human activities
  - 2.1.1. Combustion of fossil fuels in industry, transport, electricity generation, households, etc.
  - 2.1.2. Deforestation
  - 2.1.3. Agricultural farming
- 2.2. Climate change and Infrastructure
  - 2.2.1. Buildings infrastructure
  - 2.2.2. Transportation infrastructure
  - 2.2.3. Energy infrastructure
  - 2.2.4. Water and waste infrastructure
- 2.3. Technological options for mitigating climate change  
Mitigation technologies and practices, environmentally effective policies, measures and instrument, key constraints and opportunities in the following sectors
  - 2.3.1. Energy supply
  - 2.3.2. Transport
  - 2.3.3. Buildings
  - 2.3.4. Industry
  - 2.3.5. Agriculture
  - 2.3.6. Forestry/forests
  - 2.3.7. Waste
- 2.4. Adaptation measures  
Adaptation options/strategy, underlying policy frame, key constraints and opportunities to implementation by sector
  - 2.4.1. Water
  - 2.4.2. Agriculture
  - 2.4.3. Infrastructure and settlement
  - 2.4.4. Human health
  - 2.4.5. Tourism
  - 2.4.6. Transport
  - 2.4.7. Energy



- 2.4.8. Biodiversity and ecosystem
- 2.5. Risk analysis and climate change
  - 2.5.1. Identify the impacts and the level of risk
  - 2.5.2. Compare the risks posed by a climate change
  - 2.5.3. Prioritize adaptation policy
  - 2.5.4. Assess the costs and benefits of adaptation actions (quantitative risk analysis)
  - 2.5.5. Preparation and planning
  - 2.5.6. Integration with existing risk management practices
  - 2.5.7. Integration with other activities

**3. Economics (8 hours)**

- 3.1. Population growth & economic growth as climate-change drivers
- 3.2. Costs of abatement, adaptation, and impacts
- 3.3. Consequences of alternative regimes of action & inaction for economic growth, employment, trade
- 3.4. Carbon trade. Economic analysis of CDM and other GHG mitigation projects
- 3.5. Socio-economic impacts of climate change in Nepal
- 3.6. Funding sources

**4. Policies (8 hours)**

- 4.1. The Montreal Protocol, agenda 21
- 4.2. UNFCCC and The Kyoto Protocol
- 4.3. National adaptation program of action (NAPA) to climate change, Ministry of Environment, 2010
- 4.4. Hydropower Development Policies 1992 and 2001
- 4.5. Rural Energy Policy 2006
- 4.6. Climate Change Policy in Nepal 2011

**5. Legal aspects (4 hours)**

- 5.1. Water Resources Act 1992
- 5.2. Environment Protection Act 1997 & Rule 1997
- 5.3. Forest Act 1993
- 5.4. Forest regulation 1995

**Tutorials:**

- 1. Introduction (2 hours)  
impacts likely to be on farms, forests, fisheries, agriculture, water resources, health, property, ecosystems etc
- 2. Technology (2 hours)
  - 2.1. The role of humans & their technology in causing climate change

- 2.2. Technological options for mitigating climate change
- 2.3. Technological options for adapting to it
- 3. Economics (7 hours)
  - 3.1. Determination of costs of abatement, adaptation, and impacts
  - 3.2. Consequences of alternative regimes of action & inaction for economic growth, employment, trade
- 4. Policy (on climate change) (4 hours)
  - 4.1. Policy options and their impact on outcomes
  - 4.2. Actors and interests in the climate debate...and the evolution of perceptions & interests over time
  - 4.3. Finding a global climate-policy framework that is adequate, equitable, and attainable
  - 4.4. Uncertainty and prudence in public policy

**Project works:**

- 1. Concepts and development of cause and effect of greenhouse gases, consequences of change in natural greenhouse gases.
- 2. The role of humans & their technology in causing climate change.
- 3. Technological options for mitigating climate change.
- 4. Consequences of alternative regimes of action & inaction for economic growth, employment, trade.
- 5. Policy options and their impact on outcomes
- 6. Uncertainty and prudence in public policy on climate

**References:**

- 1. Holdren, 2007,
- 2. www.AAAS.org

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	10	16
2	15	24
3	8	15
4	8	15
5	4	10
Total	45	80

\* There may be minor deviation in marks distribution.

# ENVIRONMENTAL MANAGEMENT SYSTEM

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

## Course Objective:

The objective of the course is aimed at teaching the students the functions of the various aspects of environmental pollution, wastewater management, air pollution, solid waste management, different environmental management tools and techniques, Environmental Management System (EMS) and ISO 14001. The assignment and class work are expected to give students an in-depth analysis of the environmental management system.

### 1. Introduction (3 hours)

- 1.1. Concept of environment
- 1.2. Classification of environment
- 1.3. Introduction to environmental pollution
- 1.4. Pollution and pollutants
  - 1.4.1. Water pollution
  - 1.4.2. Air pollution
  - 1.4.3. Land/soil pollution
  - 1.4.4. Ground water pollution
  - 1.4.5. Noise pollution
  - 1.4.6. Visual pollution
- 1.5. Harmfulness of pollutants

### 2. Environment and health (4 hours)

- 2.1. Relation between environment and human health
- 2.2. Adverse effects of environmental pollution
  - 2.2.1. Effects of water pollution
  - 2.2.2. Effects of air pollution
  - 2.2.3. Effects of land pollution
- 2.3. Ecological risk assessment
  - 2.3.1. Introduction to eco-toxicology
  - 2.3.2. Risk assessment

### 3. Environment management (3 hours)

- 3.1. Introduction to environment management
- 3.2. Historical evolution
- 3.3. Environment management tools and techniques

3.4. Benefits of environment management

### 4. Wastewater management (3 hours)

- 4.1. Concept of wastewater management
- 4.2. Forms of wastewater management
  - 4.2.1. Off-site system
  - 4.2.2. On-site sanitation system
- 4.3. Types of wastewater treatment technologies
  - 4.3.1. Waste stabilization ponds
  - 4.3.2. Activated sludge process
  - 4.3.3. Constructed wetlands
- 4.4. Overview of wastewater management system in Nepal

### 5. Air Pollution (3 hours)

- 5.1. Concept of air pollution
- 5.2. Forms of air pollution
  - 5.2.1. Indoor air pollution
  - 5.2.2. Acid rain
  - 5.2.3. Ozone depletion
  - 5.2.4. Greenhouse gas effect
- 5.3. Air Pollution Management Techniques
  - 5.3.1. Cyclone
  - 5.3.2. Filters
  - 5.3.3. Liquid scrubbing
  - 5.3.4. Electrostatic precipitation (ESP)
- 5.4. Overview of air pollution in Nepal

### 6. Solid waste management (4 hours)

- 6.1. Concept of solid waste management
- 6.2. Collection
- 6.3. Transfer station/Sanitary landfill site
- 6.4. Principles of 3R
- 6.5. Overview of solid waste management in Nepal
  - 6.5.1. River intakes
  - 6.5.2. Reservoir intakes
  - 6.5.3. Spring intakes

### 7. Cleaner Production (2 hours)

- 7.1. Concept of pollution prevention
- 7.2. Definition of Cleaner Production (CP)
- 7.3. CP techniques
- 7.4. Implementation procedure
- 7.5. Overview of CP intervention in Nepal

**8. Energy Efficiency (2 hours)**

- 8.1. Concept of energy efficiency
- 8.2. Areas for energy efficiency
  - 8.2.1. Electrical
  - 8.2.2. Thermal
- 8.3. Energy efficiency techniques
- 8.4. Stages of energy efficiency improvement
- 8.5. Overview of energy efficiency in Nepal

**9. Clean Development Mechanism (2 hours)**

- 9.1. Concept of global warming
- 9.2. Climate change
- 9.3. Kyoto Protocol
- 9.4. Flexible mechanism
  - 9.4.1. Carbon trading
  - 9.4.2. Joint implementation
  - 9.4.3. Clean Development Mechanism (CDM)
- 9.5. Principles of CDM
- 9.6. Overview of CDM in Nepal

**10. Environmental Management System (12 hours)**

- 10.1. Definition of environmental management system (EMS)
- 10.2. Basic concept of EMS
  - 10.2.1. Plan
  - 10.2.2. Do
  - 10.2.3. Check
  - 10.2.4. Act
- 10.3. Components of EMS
  - 10.3.1. Environmental review
  - 10.3.2. Environmental policy
  - 10.3.3. Environmental objectives and targets
  - 10.3.4. Environmental management programme (EMP)
  - 10.3.5. Internal audit
- 10.4. Types of EMS
  - 10.4.1. Local
  - 10.4.2. Country specific
  - 10.4.3. Regional
  - 10.4.4. ISO 14001
- 10.5. Benefits of EMS

**11. ISO 14001 (3 hours)**

- 11.1. Introduction to ISO 14001

- 11.2. Basic concept of ISO 14001

- 11.3. Scope of ISO 14001

- 11.4. Structure of ISO 14001

**12. Environmental laws and regulations (4 hours)**

- 12.1. Introduction to environmental laws and regulations

- 12.2. Overview of environmental laws and regulations in Nepal

- 12.3. Environment protection act & regulations

- 12.4. Solid waste management actStandards

- 12.4.1. Wastewater standar

- 12.4.2. Ambient air quality standard

**Tutorials:**

- 1. Introduction (1 hour)

- Definitions, examples of pollution and pollutants

- 2. Environmental health (1 hour)

- Health impacts of pollution, nNumericals on risk assessment, LD50method

- 3. Environment management (1 hours)

- Definitions, dilution, treatment, prevention, examples on different environment management tools and techniques

- 4. Wastewater management (1 hours)

- Definitions, advantages and disadvantages of centralized and decentralized treatment systems, design criteria, pipe materials, examples of WWTPsnumericals on network

- 5. Air pollution (1 hour)

- Definitions, reactions of air pollutants, examples of air pollution control technologies

- 6. Solid waste management (1 hours)

- Definitions, management systems, numericals on transportation, examples

- 7. Cleaner production (1 hours)

- Definitions, examples of various techniques with figures

- 8. Energy efficiency (1 hour)

- Definitions, typical figures of energy savings

- 9. Clean development mechanism (1 hour)

- Definitions, typical figures of carbon trading

- 10. Environmental management system (4 hours)

- Definitions, numerical on environmental review, targets and EMP

- 11. ISO 14001 (1 hour)

- Definitions, Typical figures on certified companies

- 12. Environmental laws and regulations (1 hour)

- Definitions, typical figures on standards

**Practical:**

1. Environmental impacts of pollutants
2. Environmental management tools & techniques
3. Environmental review
4. Environmental management program (EMP)

**References:**

1. M.L.Davis and D.A.Cornwell, "Introduction to Environmental Engineering", McGraw-Hill, 1998
2. Tchobanoglous, Theisin and Vigil, "Integrated Solid Waste Management – Engineering Principles and Management Issues", McGraw-Hill, 1993
3. R. Drostie, "Theory and practice of water and wastewater treatment", John Willey & Sons, Inc., 1997
4. ISO, "ISO 14001: Guidance for use", 2004.
5. MOEST, "EPA & Regulations, 2053", Kathmandu
6. SWMTSC, "Solid waste management act, 2011". 2011
7. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Water Supply Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
8. P.N. Modi, "Water Supply Engineering", Standard Book House, Delhi, 1998
9. G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering", DhanpatRai Publishing Company (P) Ltd., New Delhi, 2002
10. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd., New Delhi, 1997

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	3	4
2	4	4
3	3	8
4	3	8
5	3	8
6	4	14
7	2	10
8	2	4
9	2	4
10	12	12
11	3	2
12	4	2
Total	45	80

\* There may be minor deviation in marks distribution.

## RURAL ROAD ENGINEERING CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### Course Objectives:

The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field planning, design, construction and maintenance of rural roads. The course includes the details of practical considerations based on the socio-economic and technical aspect of rural areas of Nepal.

- 1. Introduction [2 hours]**
  - 1.1. General Background
  - 1.2. Introduction to Green Road
  - 1.3. Characteristics of Green Road
  - 1.4. Objectives of Green Road
  - 1.5. Green Road in context of Nepal
  
- 2. Rural Roads Planning [4 hours]**
  - 2.1. District Transport Planning
  - 2.2. Goal
  - 2.3. Objectives
  - 2.4. Community/Stakeholders: 4 Key Actors
  - 2.5. Legislative Body
  - 2.6. Executive Body
  - 2.7. Judicial Body
  - 2.8. Implementing Agencies
  - 2.9. Steps To Prepare DTMP Based on Best Practice Report
  - 2.10. Actions To Prepare DTMP Based on DoLIDAR APPROACH
  - 2.11. RAP Process
  - 2.12. Planning Process
  - 2.13. Technical Issues/Discussions
  
- 3. Geometric Design and Standards [12 hours]**
  - 3.1. Road classification, traffic and loading
  - 3.2. Design
  - 3.3. Design speed
  - 3.4. Horizontal curves

- 3.5. Minimum radius of horizontal curve
- 3.6. Super elevation
- 3.7. Extrawidening on curves
- 3.8. Sight distance
- 3.9. Vertical curves
- 3.10. Minimum radius
- 3.11. Length and the ordinates of vertical curves
- 3.12. Hairpin bends
- 3.13. Vertical clearance
- 3.14. Lateral clearance
- 3.15. Right of way
- 3.16. Bypass
- 3.17. Formation width
- 3.18. Camber slope
- 3.19. Carriageway width
- 3.20. Cross section
- 3.21. Longitudinal gradient
- 3.22. Drainage
- 3.23. Retaining structures
- 3.24. Design standards for green roads

- 4. Implementation [6 hours]**
  - 4.1. Technical support
  - 4.2. Management support
  - 4.3. Lean management technology
  - 4.4. Performance based work assignment
  - 4.5. Decentralized institutional arrangement
  - 4.6. Social mobilization support
  
- 5. Construction Technology [6 hours]**
  - 5.1. Alignment selection
  - 5.2. Road survey, design and estimates
  - 5.3. Construction methods
  - 5.4. Training
  - 5.5. Labor based construction
  - 5.6. Rock cutting techniques
  - 5.7. Haulage and transportation of excavated materials
  - 5.8. Construction material
  - 5.9. Use of flexible retaining and cross drainage structures
  - 5.10. Natural compaction
  - 5.11. Tools and equipment
  - 5.12. Phased, staged, Sectoral construction

**6. Environmental Conservation [5 hours]**

- 6.1. Minimization of slope cutting and preservation
- 6.2. Mass balancing
- 6.3. Reuse of excavated materials
- 6.4. Bioengineering
- 6.5. Proper water management

**7. Economic analysis of green roads [5 hours]**

- 7.1. General Economic Consideration
- 7.2. Cost of Green Road
- 7.3. Construction Cost
- 7.4. Maintenance Cost
- 7.5. Rehabilitation Cost
- 7.6. Economic Justification
- 7.7. Resource Mobilization
- 7.8. Public Auditing

**8. Maintenance and Rehabilitation [5 hours]**

- 8.1. Minimization of maintenance requirements
- 8.2. Mitigation measures
- 8.3. Types of maintenance
- 8.4. Sustainable maintenance funding
- 8.5. Rehabilitation
- 8.6. Upgrading

**Tutorial:**

Three assignments that include the design of a rural road project, construction technology and maintenance arrangements

**Practical:**

One day field visit to a rural roads and study of anomalies, preparation of the report and its presentation

**References:**

1. "Principles of Urban transport planning" ,B.C.Huchinson, McGraw Hill publishing company.,
2. " introduction to transportation engineering and planning", E. K. Morlok, international student edition, McGraw Hill publishing company, 1987,
3. "transportation Engineering" Volume I and II V. N. Vazirani and S.P.Chandola ,Khanna Publishers, Delhi, India

**Evaluation Scheme**

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

Chapter	Hours	Marks Distribution*
1	2	4
2	4	8
3	12	20
4	6	10
5	6	10
6	5	8
7	5	10
8	5	10
Total	45	80

\* There may be minor deviation in marks distribution.

# TRAFFIC AND TRANSPORT MODELING

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

## Course Objective:

The objective of this course is to get insight regarding mathematical models for the estimation of transport demand in the framework of transportation planning. The course is presented to provide the following contemporary concepts:

- Conceptual knowledge in transportation system
- Functions of models in transportation system analysis
- Types of models and their applications
- Aggregated models for trip generation, trip distribution, modal split and network assignment
- Estimation of model parameters and calibration

### 1. Introduction [5 hours]

- 1.1. Background: Traffic and Transportation Engineering
- 1.2. Introduction to Transportation planning
- 1.3. Models and model developing process
- 1.4. Characteristics of transport problems
- 1.5. Issues in transport planning and modeling

### 2. Mathematical prerequisites [6 hours]

- 2.1. Algebra and functions
- 2.2. Functions and graphs
- 2.3. Use of engineering statistics in transportation problems (Binomial distribution, Poisson distribution, Negative binomial distribution, negative exponential distribution, normal distribution, Regression analysis)

### 3. Data and Space [4 hours]

- 3.1. Basic sampling theory
- 3.2. Data collection methods
- 3.3. Network and Zoning System

### 4. Traffic Forecasting [4 hours]

- 4.1. Need for traffic forecasting
- 4.2. Forecast based on past trends

4.3. Mathematical models for traffic forecasting

### 5. Transportation Survey [6 hours]

- 5.1. Introduction and types of surveys
- 5.2. Home interview survey
- 5.3. Roadside interview survey
- 5.4. Inventory of transport facilities
- 5.5. Inventory of land-use and economic activities

### 6. Trip Generation Modeling [5 hours]

- 6.1. Introduction and definition
- 6.2. Trip classification
- 6.3. Factors affecting trip generation
- 6.4. Trip generation analysis: (Growth factor modeling, regression analysis, category analysis)

### 7. Trip Distribution Modeling [5 hours]

- 7.1. Introduction and definition
- 7.2. Growth factor methods (uniform, average growth factor, Fratar method, Furness method)
- 7.3. Gravity models

### 8. Modal Split Model [5 hours]

- 8.1. Introduction
- 8.2. Factors affecting mode choice
- 8.3. Types of modal split models, logit model and its application

### 9. Trip Assignment [5 hours]

- 9.1. Basic concepts
- 9.2. Application of trip assignment
- 9.3. Procedure of trip assignment (minimum path technique, minimum path with capacity restraint, BPR method, diversion curves, user equilibrium assignment, system optimization assignment, other assignment methods)

## Tutorials:

1. Probability distribution, regression analysis [2 hours]
2. Sampling theory, Sample size estimation [1 hour]
3. Trip generation analysis [4 hours]
4. Trip distribution analysis [4 hours]
5. Modal split model [2 hours]
6. Trip assignment [2 hours]

**Practical / Assignment:**

1. Review of previous transportation study report (like Kathmandu valley transportation study)
2. Application of geo-informatics in transportation planning
3. Traffic and transport study

**References**

1. Traffic Engineering and Transport Planning. L.R. Kadiyali, Khanna Publishers, Delhi, 2000.
2. Transportation Engineering & Planning, Third Edition (Indian Reprint). C. S. Papacostas& P. D. Prevedouros. Prentice-Hall of India, New Delhi.2002.
3. Urban Transportation planning. Michael D. Meyer & Eric J. Miller. McGraw Hill, 2002.
4. Highway Engineering. S.K. Khanna& C. E. G. Justo. Nem CHAND & BROS; Roorkee, 2000.
5. Modeling Transport, Third Edition. Juan de Dios Ortuzar and Luis G. Willumsen. John Willey & Sons, USA, 2004.

**Evaluation Scheme**

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

Chapter	Hours	Marks Distribution*
1	5	8
2	6	8
3	4	8
4	4	
5	6	8
6	5	12
7	5	12
8	5	12
9	5	12
Total	45	80

\* There may be minor deviation in marks distribution.



## ROCK MECHANICS

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field of geotechnical engineering. The course includes the advanced techniques that are not dealt in the courses of soil mechanics and foundation engineering.

1. **Scope of rock mechanics** [2 hours]
2. **Nature of rocks** [2 hours]
3. **Classification and index properties of rocks** [4 hours]
  - 3.1. Geological classification
  - 3.2. Index properties of rock system
  - 3.3. Porosity
  - 3.4. Density
  - 3.5. Permeability
  - 3.6. Strength
  - 3.7. Slaking and durability
  - 3.8. Sonic velocity as an index to degree of fissuring
4. **Rock strength and failure criteria** [7 hours]
  - 4.1. Modes of failures of rock
  - 4.2. Common lab strength tests
  - 4.3.  $\sigma$ - $\epsilon$  behavior in compression
    - $\sigma$ - $\epsilon$
    - hydraulic compression
    - deviatoric compression
    - effect of  $\sigma_3$
  - 4.4. meaning of rock strength
  - 4.5.  $\sigma$ - $\epsilon$  curve
  - 4.6. Mohr- Coulomb failure criteria
  - 4.7. Effect of water
  - 4.8. Empirical failure criteria
  - 4.9. Effect of size on strength
  - 4.10. Anisotropic rocks
5. **Initial stresses in rocks and their measurement** [7 hours]
  - 5.1. Influence of the initial stresses
  - 5.2. Estimating the initial stresses
    - horizontal stresses
    - vertical stresses
    - horizontal stresses direction
  - 5.3. techniques for measurements of In-situ stresses
    - hydraulic fracturing
    - flat jack method
    - over coring
6. **Planes of weaknesses in rock** [4 hours]
  - 6.1. joint orientation
  - 6.2. joint testing
  - 6.3. joint roughness
  - 6.4. effect of water pressure
7. **Deformability of rocks** [5 hours]
  - 7.1. elastic and non-elastic behavior
  - 7.2. elastic constants
  - 7.3. measurements of deformability
    - **lab compression test**
    - plate bearing test
    - borehole and gallery test
    - radial jacking test
    - flat jack test
    - dynamic measurement
    - fractured rocks
8. **Application of rock mechanics to rock slope engineering** [8 hours]
  - 8.1. modes of failure of slope in hard rock
  - 8.2. kinematic analysis of slopes
  - 8.3. analysis of plane sliding of the stereographic projection
  - 8.4. analysis of wedge sliding using stereographic projection
  - 8.5. analysis of slides composed of two blocks
9. **Application of rock mechanics to Rock slope engineering** [6 hours]
  - 9.1. modes of failure of slope in hard rock
  - 9.2. kinematic analysis of slopes
  - 9.3. analysis of plane
  - 9.4. analysis of plane sliding of the stereographic projection

- 9.5. analysis of wedge sliding using stereographic projection
- 9.6. analysis of slides composed of two blocks

**Tutorial:**

Three assignments that include the determination of shear strength, displacement and analysis of slides using stereographic projection

**Practical:**

Rock strength test, different test for deformability

**References:**

1. Principles of Geotechnical Engineering” , B.M. Das, Boston PWS Engineering, 1985
2. Cook, N.G.W. et al. (1966) Rock Mechanics applied to Rockbursts – a synthesis of the results of rockburst research in South Africa up to 1965. J. S. African Inst. Min. Metall. Vol. 66, No. 10, 435-528.
3. Ortlepp, W.D. and Cook, N.G.W. (1965) The measurement and analysis of the deformation around deep, hard-rock excavations. Proc. 4th Intl.Conf. on Rock Mech. And Strata Control. New York, 140-152.
4. Leeman, E.R. (1964) Remote measurement of rock stress under development in Rock Mechanics
5. Leeman, E.R. (1964) The measurement of stress in rock. Parts I to III. J. S. African Inst. Min. and Metall. Vol 65, No. 2, 48-114 and Vol 65, No. 4, 254-284.
6. Leeman, E.R. and Hayes, D.J. (1966) A technique for determining the complete state of stress in rock using a single borehole. Proc. 1st Intl. Cong. on Rock Mechanics. Lisbon.

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distributions *
1	2	4
2	2	4
3	4	8
4	7	12
5	7	12
6	4	8
7	5	10
8	8	12
9	6	10
Total	45	80

\* There may be minor deviation in marks distribution.

# TRAFFIC ENGINEERING AND MANAGEMENT

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

## Course objective:

The main objective of this course is to introduce the concepts of characterizing traffic, various modeling approaches, and design of facilities to control and manage traffic. The course mainly focuses on urban vehicular movement.

- 1. Traffic stream characteristics [4hours]**
  - 1.1. Introduction
  - 1.2. Fundamental parameters and relations of traffic flow
  - 1.3. Traffic stream models (Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, Pipe's model, multi regime model)
- 2. Traffic measurement [4hours]**
  - 2.1. Volume measurement
  - 2.2. Speed measurement
  - 2.3. Travel time, density measurement
  - 2.4. Automatic traffic measurement techniques
- 3. Traffic flow modeling [4hours]**
  - 3.1. Car following models
  - 3.2. Lane changing models
  - 3.3. Vehicle arrival models
  - 3.4. Traffic progression models
- 4. Uninterrupted traffic flow [8hours]**
  - 4.1. Capacity and level of service concepts
  - 4.2. Urban streets: classification, performance measurement (HCM method), congestion management
  - 4.3. Multilane highways: characteristics, capacity and level of service
  - 4.4. Capacity and level of service of basic freeway section
  - 4.5. Ramp metering
- 5. Intersection Control [8hours]**
  - 5.1. Principles of traffic control
  - 5.2. Uncontrolled intersection

- 5.3. Traffic signs and road markings
- 5.4. Channelization
- 5.5. Rotary intersection
- 5.6. Grade separated intersections

- 6. Traffic signal design [10hours]**
  - 6.1. Elements of traffic signal
  - 6.2. Design principles of traffic signal
  - 6.3. Delay models for signal evaluation
  - 6.4. Capacity and level of service of signalized intersection
  - 6.5. Coordinated traffic signal control
  - 6.6. Actuated traffic signal control
  - 6.7. Area traffic control
- 7. Specific traffic studies [7hours]**
  - 7.1. Parking studies
  - 7.2. Accident studies
  - 7.3. Fuel consumption and emission studies
  - 7.4. Congestion studies
  - 7.5. Queuing analysis
  - 7.6. Toll operation
  - 7.7. Pedestrian studies
  - 7.8. Intelligent transportation system

## Tutorials:

1. Relation between traffic flow parameters [1 hour]
2. Time mean speed, space mean speed, density, headway, gap [1 hour]
3. Traffic flow modeling [2 hours]
4. Uninterrupted traffic flow [4 hours]
5. Conflict areas in intersection , Rotary intersection [1 hour]
6. Signal evaluation [1 hour]
7. Capacity and level of service of signalized intersection [2 hours]
8. Parking studies, Accident studies [1 hour]
9. Congestion studies, Queuing analysis (M/M/1) [1 hour]
10. Toll operation, pedestrian studies [1 hour]

## Practical/Assignment:

1. Classified intersection traffic volume count
2. Traffic volume count at freeway section
3. Accident report
4. Parking supply survey

5. Pedestrian study
6. Intersection improvement proposals

**References:**

1. Roess, RP.,McShane, WR. andPrassas, ES. (1998), Traffic Engineering, Prentice Hall.
2. Papacostas, C. S. (1987), Fundamentals of Transportation Engineering, Prentice Hall.
3. Kadiyali, LR (1987), Traffic Engineering and Transportation Planning, Khanna.
4. Highway Capacity Manual (2000), Transportation Research Board, USA.
5. Khanna, S. K. and Justo, C. E. G. (1991), Highway Engineering, Nemchand.

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution*
1	4	8
2	4	8
3	4	8
4	8	16
5	8	12
6	10	16
7	7	12
Total	45	80

\* There may be minor deviation in marks distribution.

## ADVANCED GEOTECHNICAL ENGINEERING

EG .....

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field of geotechnical engineering. The course includes the advanced techniques that are not dealt in the courses of soil mechanics and foundation engineering.

1. **Scope of advanced geotechnical engineering** [2hours]
  - 1.1. Field of application of advanced geotechnical engineering
  - 1.2. Different sectors of geotechnical engineering
2. **Field instrumentation and monitoring** [12hours]
  - 2.1. Types of field measurements and their uses
  - 2.2. Monitoring displacements of foundations and structures: vertical and horizontal displacement
  - 2.3. Monitoring slope\rock mass movement: slope movement using borehole extensometers, inclinometers and tiltmeters: rockmass displacement in underground excavations etc. using optical electro-optical methods of borehole extensometers
  - 2.4. Monitoring **pressures\ loads in earth**: walls and structures; monitoring pressures in the body of earth structures
  - 2.5. Monitoring In-situ stresses in rock; hydraulic fracture techniques, direct stress measurement techniques; and borehole methods
  - 2.6. Monitoring pore water pressure: methods based on various types of piezometers, selection of piezometers to suit the ground condition
  - 2.7. Recording and data handling
3. **Geosynthesis** [9hours]
  - 3.1. Types of geosynthesis
  - 3.2. Application of geosynthesis drainage, filtration reinforcement and separation
  - 3.3. Design consideration: physical properties, mechanical/hydraulic durability requirements
  - 3.4. Construction requirements: site preparation, selection of equipment, placement and compaction requirements
4. **Anchors, Rock Bolts and Shotcrete** [9hours]

- 4.1. Application and types of anchors and rock bolts
- 4.2. Design criteria: safety against uplift, overturning, tangential displacement, shear failure and caving in
- 4.3. Installation: drilling, insertion, grouting (anchoring) stressing and final grouting
- 4.4. Mechanism of load transfer in anchors
- 4.5. Testing of anchors
- 4.6. Protection from corrosion
- 4.7. Selection of materials and mix design of shotcrete
- 4.8. Engineering properties of shotcrete
- 4.9. Placement of shotcrete

### 5. Grouting [4hours]

- 5.1. Purpose of grouting
- 5.2. Classification of grouting materials
- 5.3. Characteristics of good grouting materials: viscosity, setting time, permeability of grouting works
- 5.4. Planning of grouting works
- 5.5. Selection of grouting materials
- 5.6. Grouting methods
- 5.7. Control of grouting works

### 6. Geotechnical earthquake engineering [9hours]

- 6.1. Earthquakes
- 6.2. Ground shaking
- 6.3. Liquefaction
- 6.4. Surface rupture
- 6.5. Other permanent Ground Deformatons
- 6.6. Tsunamis and Seiches
- 6.7. Seismic provisions in Building Codes

### Tutorial:

Three assignments that include the design of anchor and planning of geosynthesis and grouting

### Practical:

One day field study on the application of grouting, anchoring and geosynthetics and preparation of report.

**References:**

1. Principles of Geotechnical Engineering” , B.M. Das, Boston PWS Engineering, 1985
2. “Engineering Principles of Ground Modifications” , M. R. Housmann. McGraw-Hill Co. , 1990, New York
3. “Grouting in engineering practice” , R. Bowen, Allied Science Pub. , London, 1981

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distributions *
1	2	4
2	12	20
3	9	16
4	9	16
5	4	8
6	9	16
Total	45	80

\* There may be minor deviation in marks distribution.

## DESIGN OF BRIDGES

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year IV  
Part II

### Course objectives:

- Introduce bridge structures & their types and make capable to select appropriate bridge type
- Make capable to analyze and design simple reinforced concrete and steel bridge deck, bridge bearing and substructure of bridge
- Familiarize with the method of construction and maintenance of bridges

- 1. Introduction to Bridge Structures and Fundamentals of Bridge Design. [6 hours]**
  - 1.1. Bridge and its components
  - 1.2. Types of bridges and their characteristics
  - 1.3. Selection of bridge type
  - 1.4. Essential design data and their acquisition
  - 1.5. General design requirements
- 2. Bridge Loading and Responses [4 hours]**
  - 2.1. Bridge loads
  - 2.2. Bridge responses
- 3. Bridge Deck Analysis and Method of Lateral Load Distribution [6 hours]**
  - 3.1. General principle and methods of bridge deck analysis
  - 3.2. Effective Width Method
  - 3.3. Courbon's Method
  - 3.4. Distribution Coefficient Method
  - 3.5. Hendry Jaeger Method
  - 3.6. Longitudinal and lateral positioning of moving loads and response
    - 3.6.1. calculation
- 4. Design of Simple Reinforced Concrete Bridge [5 hours]**
  - 4.1. Design of RC Slab Bridge
  - 4.2. Design of RC T-Beam Bridge
- 5. Design of Simple Steel Bridge [5 hours]**
  - 5.1. Design of plate girder and composite bridge
  - 5.2. Design of truss bridge

- 6. Design of Bridge Substructure [10 hours]**
  - 6.1. Design of Pier
  - 6.2. Design of Abutment
  - 6.3. Introduction to Bridge Foundation

- 7. Bridge Bearing and Expansion Joint [5 hours]**
  - 7.1. Bridge bearing
    - 7.1.1. Types of bearing
    - 7.1.2. Design of metallic bearing
    - 7.1.3. Design of elastomeric bearing
    - 7.1.4. Expansion Joint
      - 7.1.4.1. Requirement to expansion joint
      - 7.1.4.2. Types of expansion joint and their design

- 8. Construction and Maintenance of Bridge [4 hours]**
  - 8.1. Introduction to construction of bridges
  - 8.2. Introduction to maintenance of bridges

### Tutorial:

1. Exercise on the design of RC slab bridge [1.5 hours]
2. Exercise on the application of Courbon's Method, Distribution Coefficient Method and Hendry Jaeger Method [3 hours]
3. Exercise on the Design of T-Beam bridge [2 hours]
4. Exercise on the Design of Composite Bridge [2 hours]
5. Exercise on the Design of Steel Truss Bridge [2 hours]
6. Exercise on the Design of Bearing [2 hours]
7. Exercise on the Design of Pier and Abutment [2.5 hours]

### Practical:

Practical of the course consists of a minor project work and field work..

1. Every individual student is assigned with a minor project work on design of RCC/ Steel Bridge and student has to defend the project work at the end of academic semester.
2. One day field visit to bridge sites is organized. Student has to submit a visit report.

### Reference

1. Essential of Bridge Engineering; Victor, D.J. Oxford and IBH Publishing Company, New Delhi
2. Design and Construction of Highway Bridges; Rakshit, R.S.

New Central Book Agency, New Delhi

3. Analysis and Design of Substructures; Swami Saran  
Oxford and IBH Publishing Company, New Delhi
4. Bridge Analysis Simplified; BaidarBakht and Leslie G. Jaeger,  
McGraw Hill Book Company
5. Concrete Bridge Practice: Analysis, Design and Economics, V.K.Raina  
Tata McGraw – Hill
6. Concrete Bridge Practice: Construction, Maintenance and Rehabilitation;  
V.K.Raina,  
Tata McGraw – Hill
7. Standard Specifications and Codes of Practices for Road Bridges,  
IRC 5, 6, 21, 22, 24, 40, 78, 83

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution*
1	6	8
2	4	6
3	6	12
4	5	12
5	5	12
6	10	14
7	5	10
8	4	6
Total	45	80

\* There may be minor deviation in marks distribution.



# EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

## Course objectives:

To understand the nature of earthquakes, behavior of structures under the ground motion, and learn the analysis and design of structures subjected to earthquake ground motions.

- 1. Seismological aspects [4 hours]**
  - 1.1. Causes of earthquakes
  - 1.2. Theory of plate tectonics
  - 1.3. Faults and fault mechanism
  - 1.4. Seismic waves
  - 1.5. Measures of earthquake
  - 1.6. Seismic hazards
  - 1.7. Types of vibration
  - 1.8. Response of structures to vibration
- 2. Earthquake Ground Motion [10 hours]**
  - 2.1. Attenuation Laws
  - 2.2. Ground motion parameters
  - 2.3. Local site effects
  - 2.4. Soil amplification
  - 2.5. Duhamel Integral for SDOF for earthquake ground motion
  - 2.6. Liquefaction effect
  - 2.7. Response Spectrums of Earthquakes
  - 2.8. Seismic zoning
  - 2.9. Seismic hazard analysis
  - 2.10. Review of random variables and probability theory
  - 2.11. Probability distribution functions
  - 2.12. Conditional probability and Baye's theorem
  - 2.13. Deterministic seismic hazard analysis (DSHA)
  - 2.14. Probabilistic seismic hazard analysis (PSHA)
  - 2.15. Seismic hazard curve and return period

- 3. Linear Dynamic analysis of structures [8 hours]**
  - 3.1. Response of SDOF system to support movement/earthquake ground motion
  - 3.2. Vibration frequencies and mode shapes of MDOF system
  - 3.3. Mode superposition method
  - 3.4. Mode participation factors
  - 3.5. Effective modal mass
  - 3.6. Response spectrum analysis of MDOF system
  - 3.7. Pseudo Static Force in Each Mode of Vibration due to Earthquake
  - 3.8. Maximum responses due to effects of all modes
- 4. Lateral Load Resisting Systems for Buildings [10 hours]**
  - 4.1. Different structural systems for lateral loads.
  - 4.2. Floor diaphragms
  - 4.3. Lateral load distribution with rigid floor diaphragms
  - 4.4. Moment resisting frames
  - 4.5. Lateral load distribution in frame buildings
  - 4.6. Shear walls
  - 4.7. Shear wall with openings
  - 4.8. Frame – shear wall dual system
  - 4.9. Building configuration implications
- 5. Methods of Analysis for Earthquake Resistant Design [7 hours]**
  - 5.1. Principles of earthquake resistant design
  - 5.2. Equivalent lateral load procedure
  - 5.3. Dynamic analysis procedure
  - 5.4. Drift evaluation and verification
  - 5.5. Diaphragm effect
  - 5.6. Torsional response
  - 5.7. Other major code provisions
- 6. Design of Structures for Earthquakes [6 hours]**
  - 6.1. Plastic design of structures for earthquakes
  - 6.2. Ductility and energy absorption in buildings
  - 6.3. Reinforced concrete for earthquake resistance
  - 6.4. Confinement of concrete for ductility
  - 6.5. Ductile detailing of reinforced concrete structures
  - 6.6. Effect of infill masonry walls on frames
  - 6.7. Problems of soft and weak stories
  - 6.8. Capacity design procedures
  - 6.9. Behavior of masonry buildings during earthquakes
  - 6.10. Failure mechanisms of masonry walls

- 6.11. Strength of masonry in shear and flexure
- 6.12. Concepts for earthquake resistant masonry buildings

**Tutorial:**

There shall be related tutorial exercised in class and given as regular home work exercises.

**Practical:**

The students shall work on a course project on earthquake resistant design of structures on agreement with the course coordinator. Generally the course project work will base on the prevalent national or international seismic codes. The report on the individual course project shall be submitted at the end of the semester, and will be scored based on the quality of the project report.

**References:**

1. Newmark, N. M., and Rosenblueth, E., **Fundamentals of Earthquake Engineering**, Prentice-Hall, Inc. Englewood Cliffs, N. J., 1971.
2. Kramer, S. L., **Geotechnical Earthquake Engineering**, Prentice -Hall, 1996.
3. Dowrick D., **Earthquake Resistant Design and Risk Reduction**, John Wiley & Sons, 2009.
4. Chopra A. K., **Dynamics of Structures: Theory and Applications to Earthquake Engineering**, Prentice Hall, 2007.
5. Clough R. W., Penzien J, **Dynamics of Structures**, 2nd edition: McGraw Hill 1993.

**Evaluation Scheme:**

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

Chapters	Hours	Marks Distribution *
1	4	8
2	10	16
3	8	16
4	10	16
5	7	14
6	6	10
Total	45	80

\* There may be minor deviation in marks distribution.

# VULNERABILITY ASSESSMENT AND RETROFITTING TECHNIQUE CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

## Course Objectives:

The course provides practical information on vulnerability assessment of existing buildings and retrofitting technique. This course deals with vulnerability assessment of existing buildings and in this part students will learn qualitative and quantitative assessment process and will be able to carry out the qualitative assessment and concept on detail structural assessment method and analysis. The students will also learn the testing methods to estimate the properties of material on existing structures- non destructive, semi destructive and destructive. The course deals with design technique on retrofitting and in these part students will learn design principles and various types of retrofitting technique along with construction detail. The students will be able to carry out the qualitative assessment, concept on detail analysis, testing methods and retrofitting technique.

- 1. Introduction [ 3 hours]**
  - 1.1. Earthquake and cause
  - 1.2. Seismic Risk
  - 1.3. Risk Reduction
  - 1.4. Building Typology in Nepal
- 2. Procedure for buildings evaluation [10 hours]**
  - 2.1. General background
  - 2.2. Evaluation methods
    - 2.2.1. Qualitative evaluation method
    - 2.2.2. Quantitative evaluation method
- 3. Level of seismic protection and seismic risk classes [4 hours]**
  - 3.1. Seismic design force according to NBC and IS
- 4. Performance Objectives [6 hours]**
  - 4.1. Level of Performance
  - 4.2. Failure Mechanism
  - 4.3. Building behavior during past earthquakes

- 5. Introduction on Evaluation methodology - Simplified Method and low rise building [8 hours]**
  - 5.1. Principle of the method
  - 5.2. Evaluation of equivalent lateral seismic forces
  - 5.3. Computation of the shear stresses in vertical elements
  - 5.4. Verification conditions
- 6. Damage Assessment [6 hours]**
  - 6.1. Non Destructive test
  - 6.2. Semi Destructive test
  - 6.3. Destructive
- 7. Retrofitting Solution and techniques [8 hours]**
  - 7.1. Retrofitting of reinforced concrete frame structures
    - 7.1.1. Interventions that do not involve the alteration of the structural system
    - 7.1.2. Interventions that involveth the transformation of the reinforced concrete structural frames
    - 7.1.3. Interventions on reinforced concrete wall structures
  - 7.2. Interventions that do not involve the alteration of the structural system
    - 7.2.1. Interventions that involve the transformation of the reinforced concrete structural walls
  - 7.3. Interventions for masonry structures

## Tutorial /Practical:

1. Project
  - 1.1. Case study of building evaluation and retrofitting
  - 1.2. Seismic evaluation
  - 1.3. Checking of existing structure lateral stiffness
  - 1.4. Retrofitting solutions
    - 1.4.1. Retrofitting by reinforced concrete jacketing on the central span
    - 1.4.2. Retrofitting by introducing reinforced concrete shear walls
    - 1.4.3. Retrofitting by introducing steel braces
    - 1.4.4. Retrofitting by beams and columns RC jacketing
    - 1.4.5. Retrofitting by RC walls
    - 1.4.6. Retrofitting by steel bracing
2. Determination of compressive strength of existing concrete
3. Determination of steel bars in existing structures

### References

1. Assessment and Improvement of Structural Performance of building in Earthquakes, NZSEE study group on Earthquake Risk building, 2006
2. Guideline for Seismic Retrofit of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association
3. IS 1905/ SP 20
4. IS 383, 1970
5. IS 456, 2000
6. Manual On Vulnerability Assessment and Retrofitting of Existing School Buildings, HariDarshanShrestha et al, Prevention web
7. NEHRP Guidelines for the Seismic Rehabilitation of Buildings, FEMA 273
8. Nepal National Building Code (NBC) 109, 1994
9. Rehabilitation of Concrete Structures, DrB .Vidivelli, Standard Punlisher and Distributors
10. Seismic Evaluation and Retrofit of Concrete Buildings, Volume 1 and 2, ATC 40
11. Standard for Seismic Evaluation of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association
12. Technical Manual for Seismic Evaluation and Seismic Retrofit of Existing Reinforced Concrete Buildings, 2001, The Japan Building Disaster Prevention Association

### Evaluation scheme

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

Chapters	Hours	Marks distribution *
1	3	5
2	10	20
3	4	5
4	6	10
5	8	15
6	6	10
7	8	15
<b>Total</b>	<b>45</b>	<b>80</b>

\* There may be minor deviation in marks distribution.

## SEISMIC RISK ASSESSMENT

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course objectives:

The overall objective of the module is to provide make the students able to carry out probable hazard assessment and estimate probable consequences of building damage, human casualties and economic losses.

After completion of the course, the students should be able to

- Understand concept of seismic hazard and calculate probable hazard in an area
- Comprehend vulnerability function of building structures
- Integrate hazard and vulnerability in order to estimate probable damage and loss
- use risk assessment tools

### 1. Seismicity and earthquakes (4 hours)

- 1.1. Seismic sources
- 1.2. Distribution of earthquake
- 1.3. Earthquake magnitude/intensity

### 2. Earthquake Ground motion (6 hours)

- 2.1. Characteristics of earthquake motion
- 2.2. Attenuation laws
- 2.3. Uncertainties in ground motion

### 3. Seismic Hazard Analysis (10 hours)

- 3.1. Deterministic approach
- 3.2. Probabilistic approach
- 3.3. Logic trees
- 3.4. Seismic hazard maps for different return periods

### 4. Effects of local site condition (4 hours)

### 5. Exposure information and Vulnerability Analysis (6 hours)

- 5.1. Structural Vulnerability
- 5.2. Vulnerability functions
- 5.3. Concept of fragility analysis
- 5.4. Fragility curves

5.5. Estimation of damage

### 6. Determination of Seismic risk and loss (8 hours)

Integration of hazard information and vulnerability to obtain the seismic risk

### 7. Introduction to risk assessment tools (7 hours)

### Tutorial

1. Probability hazard assessment
2. Local site effects

### Project:

1. Probability Seismic Hazard Assessment
2. Development of Vulnerability Functions
3. Application of risk assessment tools like RADIUS, HAZUS and CAPRA (A selected area can be chosen)

### References

1. Robin K. McGuire. Seismic Hazard and Risk Analysis. EERI, 2004
2. Steven L. Kramer. Geotechnical Earthquake Engineering. Prentice Hall, 1995

### Evaluation Scheme:

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

Chapter	Hours	Marks Distribution *
1	4	6
2	6	8
3	10	20
4	4	12
5	6	12
6	8	12
7	7	10
Total	45	80

\* There may be minor deviation in marks distribution.

# GEOTECHNICAL EARTHQUAKE ENGINEERING

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

## Course Objective:

The knowledge of geotechnical aspect of earthquake engineering is very essential of civil engineering structures. Seismic considerations are a significant factor in the design of much of the infrastructure in seismically active countries like Nepal. This course combines the fundamental ideas learned in the previous introductory engineering geology with seismology and design aspect of earthquakes, and applies these ideas in analyzing and understanding the seismic effects on soil structures. Various concepts, theories and practices of modern geotechnical earthquake engineering will be introduced. In this course, the student will get an overall view of the nature of seismic hazards, the methods used to assess their impacts on society and the techniques available to mitigate their damaging effects.

- 1. Introduction (5 hours)**
  - 1.1. Mechanics and classification of earthquakes
  - 1.2. Seismic hazard
  - 1.3. Seismic waves – types, measures and conversion
  - 1.4. Causes of earthquakes, Plate tectonics, faults
  - 1.5. Measure of earthquakes- magnitude, intensity, seismograph
  - 1.6. Review of historical earthquakes
- 2. Strong motion seismology (6 hours)**
  - 2.1. Mechanics and classification of earthquakes
  - 2.2. Estimation of ground motion parameters
  - 2.3. Attenuation relation- model parameters, theoretical models
  - 2.4. Classifications of attenuations relations, applicability for Himalayan region
  - 2.5. Simulation of strong motions
    - 2.5.1. Earthquake source model
    - 2.5.2. Time and frequency domain characteristics
    - 2.5.3. Rupture directivity
  - 2.6. Local site effects on strong ground motions
- 3. Dynamics of single degree of freedom systems (8 hours)**

- 3.1. Free vibration of damped and undamped systems
- 3.2. Forced vibration of damped and undamped systems
- 3.3. Response spectrum concept

- 4. Seismic hazard assessment (8 hours)**
  - 4.1. Introduction
  - 4.2. Earthquake recurrence relationship
  - 4.3. Probabilistic hazard assessment methodology
    - 4.3.1. Source modeling
    - 4.3.2. Size of earthquakes
    - 4.3.3. Distance and attenuation laws
  - 4.4. Probabilistic spectra
- 5. Site Amplification and Ground Response Analysis (8 hours)**
  - 5.1. Simplified site amplification procedures
  - 5.2. Dynamic soil properties
  - 5.3. One dimensional equivalent linear site response analysis
  - 5.4. Soil structure interaction
- 6. Liquefaction (6 hours)**
  - 6.1. Definition of soil liquefaction
  - 6.2. Features of liquefaction induced damages
  - 6.3. Factor governing liquefaction
  - 6.4. Assessment of liquefaction potential
  - 6.5. Permanent displacement due to liquefaction
  - 6.6. Factor of safety against liquefaction
- 7. Seismic slope stability (4 hours)**
  - 7.1. Pseudostatic approach
  - 7.2. Newmark's sliding block method

## Tutorials:

- 1. Introduction (1 hour)**

Theory, definition and concept type questions  
Review of impact of historical earthquakes in human environment
- 2. Strong motion seismology (2 hours)**

Theory, definition and concept type questions  
Practical examples, and numerical examples types questions
- 3. Dynamics of single degree of freedom systems (3 hours)**

Theory, definition and concept type questions

Examples of free and forced SDOF method

- 4. Seismic hazard assessment (3 hours)**
- 5. Theory, definition and concept type questions (3 hours)**  
Examples of recurrences relationship and hazard assessment
- 6. Site amplification and ground response analysis (2 hours)**  
Theory, definition and concept type questions  
Practical examples of site response analysis
- 7. Liquefaction (2 hours)**  
Theory, definition and concept type questions  
Practical examples of liquefaction problems
- 8. Seismic slope stability (2 hours)**  
Theory, definition and concept type questions  
Practical examples of earth pressure problems

#### Projects

- Seismology and earthquakes, single degree of freedom systems
- Strong ground motion parameters and response analysis
- Site amplification and dynamic soil properties
- 1-D equivalent linear site response with computer program
- Analysis of seismic hazards (Liquefaction and seismic slope stability)

#### References:

1. IkuTowhata, Geotechnical Earthquake Engineering, Springer, 2007
2. Stephen L. Kramer, Geotechnical Earthquake Engineering, Prentice Hall, 1996
3. W. F. Chen and C. Scawthorn, Earthquake Engineering Handbook, CRC press LLC, 2003

#### Evaluation Scheme:

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

Chapters	Hours	Mark distribution*
1	5	8
2	6	10
3	8	15
4	8	15
5	8	15
6	6	10
7	4	7
Total	45	80

\* There may be minor deviation in marks distribution.

## STRUCTURAL RELIABILITY

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objective:

The knowledge of probabilistic design of civil engineering structures. This course includes the fundamentals of statistics and its applications in civil engineering.

#### 1. Basic Statistics(8 hours)

- 1.1. Introduction
- 1.2. Probability theory
  - 1.2.1. Introduction
  - 1.2.2. Random events
  - 1.2.3. Random variables
  - 1.2.4. Functions of random variables
  - 1.2.5. Moments and expectation
  - 1.2.6. Common probability distributions

#### 2. Resistance distributions and parameters (10 hours)

- 2.1. Introduction
- 2.2. Statistics of properties of concrete, steel and other building materials
- 2.3. Statistics of dimensional variations
- 2.4. Characterization of variables, allowable stresses based on specified reliability
- 2.5. Probabilistic analysis of loads: gravity loads, wind loads

#### 3. Basic Structural reliability (12 hours)

- 3.1. Introduction
- 3.2. Computation of structural reliability
- 3.3. Level 2 Reliability methods
  - 3.3.1. Introduction
  - 3.3.2. Basic variables and failure surface
  - 3.3.3. First order second moment methods (FOSM)
- 3.4. Reliability based design
  - 3.4.1. Determination of partial safety factors
  - 3.4.2. Development of reliability based design criteria
  - 3.4.3. Optimal safety factors

#### 4. Monte Carlo Method (15 hours)

- 4.1. Monte Carlo study of structural safety
- 4.2. General, Monte Carlo method, applications.
- 4.3. Reliability of Structural system
  - 4.3.1. System reliability
  - 4.3.2. Modeling of structural systems
  - 4.3.3. Bounds of system reliability, reliability analysis of frames.

### Tutorials:

1. Basic Statistics (2 hours)  
Theory, definition and concept type questions
2. Resistance distributions and parameters (3 hours)  
Theory, definition and concept type questions  
Practical examples, and numerical examples types questions
3. Basic Structural reliability (4 hours)  
Theory, definition and concept type questions  
Practical examples of FOSM method
4. Monte Carlo Method (6 hours)  
Theory, definition and concept type questions  
Practical examples of beams and frames

### Practical:

There shall related practical assignment

### References:

1. R. Ranganathan., Reliability Analysis and Design of Structures, Tata McGraw Hill, 1990.
2. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. I Basic Principles, John Wiley & Sons, 1975.
3. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design, Vol. II Decision, Risks and Reliability, John Wiley & Sons, 1984.
4. Benjamin, J.R & Cornell, C.A., Probability, Statistics and Decision for Engineers, McGraw-Hill, 1982.
5. H. O. Madsen, S. Krenk & N. C. Lind, Methods of Structural Safety, Prentice-Hall, 1986.
6. R. E. Melchers. Structural Reliability - Analysis and prediction, Ellis Horwood Ltd, 1987.



**Evaluation Scheme:**

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

Chapters	Hours	Mark Distribution*
1	8	10
2	10	15
3	12	25
4	15	30
Total	45	80

\* There may be minor deviation in marks distribution.

## ROCK SLOPE ENGINEERING

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

The objective of the course is to contribute to the safe and economic designs of excavation and embankments in hilly areas. Other objectives are: to determine the slope sensitivity to different triggering mechanism and to test and compare different support and stabilization options.

1. **Principles for Rock Slope Stability Analysis** (2 hours)
  - 1.1. Introduction
  - 1.2. Definitions and Aims of Slope Stability Analysis
  - 1.3. Factors affecting the Slope Stability
2. **Methods for Rock Slope Stability Analysis** (5 hours)
  - 2.1. Empirical Methods
  - 2.2. Deterministic Method
  - 2.3. Probabilistic Method
  - 2.4. Numerical Modeling
3. **Quantification of Groundwater Pressure** (2 hours)
  - 3.1. Occurrence and Characteristics of Groundwater
  - 3.2. Groundwater Effects on Slope Stability
  - 3.3. Groundwater Pressure Models
4. **Quantification of Shear Strength Parameters of Discontinuities** (6 hours)
  - 4.1. Shear Strength of Planar Surface
  - 4.2. Shear Strength of Rough Surface
  - 4.3. Determination of Shear Strength on Rock Mass
  - 4.4. Influence of Water on Shear Strength
5. **Quantification of Seismic Force** (2 hours)
  - 5.1. Basic Aspects of Earthquake
  - 5.2. Determination of Earthquake Magnitude
6. **Graphical Presentation of Geological Data** (6 hours)
  - 6.1. Definition of Geological Terms
  - 6.2. Graphical Techniques for Data Problems

6.3. Evaluation of Potential Slope Problems

7. **Geological Data Collection** (6 hours)
  - 7.1. Geological Investigate
  - 7.2. Mapping of Exposed Structures
  - 7.3. Measurement of Surface Roughness
  - 7.4. Drill Coring for Structural Purpose
8. **Analysis** (12 hours)
  - 8.1. Plane Failure
  - 8.2. Wedge Failure
  - 8.3. Circular Failure
  - 8.4. Toppling
9. **Support and Lining** (4 hours)
  - 9.1. Basic Methods for Improving the Stability of Slopes
  - 9.2. Support Methods and Principles
  - 9.3. Control of Rock Falls

### Tutorial:

1. Graphical presentation of geological data
2. Design of rock slopes
3. Estimation of preventive measures for unstable slopes

### Practical: 2 days

- Field visit to potential unstable slopes
- Field report and group presentation is necessary

### Reference:

1. Hoek, E. and Bray, J. W. 1981. Rock Slope Engineering. Institute of Mining and Metallurgy, London, 358p.
2. Hoek, E. 1998. Slope stability problem in Hong Kong (Chapter 7). Course notes, Internet edition, <http://www.rockeng.utoronto.ca/hoekcorner.htm>, pp. 92 - 104.
3. Hoek, E. 1998. Development of Rock Engineering (Chapter 1). Course notes, Internet edition <http://www.rockeng.utoronto.ca/hoekcorner.htm>, pp. 1 - 17.
4. Hoek, E. 1998. Factor of safety and probability of failure (Chapter 8). Course notes, Internet edition, <http://www.rockeng.utoronto.ca/hoekcorner.htm>, pp. 105 - 114.

5. Hoek, E. 2000. Shear strength of discontinuities (Chapter 4). Course notes, Internet edition. <http://www.rockeng.utoronto.ca/hoekcorner.htm>, pp.60-72.

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution*
1	2	4
2	5	8
3	2	4
4	6	10
5	2	4
6	6	10
7	6	10
8	12	22
9	4	8
Total	45	80

\* There may be minor deviation in marks distribution.

## HILL IRRIGATION ENGINEERING

CE ....

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

This course is aimed at training the students specific engineering design considerations for canal irrigation, their operation, maintenance and management with environmental balance and farmer's participation in the hills of Nepal. The course is emphasized with the design of non-conventional micro irrigation technology such as sprinkler and drip in the remote hills of Nepal. After the completion of this elective course the students will confidently design the canal and micro irrigation projects in the remote hilly areas of Nepal.

- 1. Introduction (4 hours)**
  - 1.1. Physiographic Regions and Farming Systems of Nepal
  - 1.2. Characteristics of Hill Irrigation Systems (HIS)
  - 1.3. Need, Potentiality and Types of Irrigation Development in the Hills of Nepal
- 2. Environmental Aspects of Hill Irrigation (6 hours)**
  - 2.1. Problems of Floods, Soil Erosion and Land Slides
  - 2.2. Mountain Zone Classification
  - 2.3. Engineering and Vegetative Measures for Canal Design in Different Mountain Zones
  - 2.4. Guidelines for Hill Irrigation Design [Scheme Objectives; Agricultural Considerations;
  - 2.5. Managerial, Social and Institutional Arrangements; Financial Provisions and Engineering solutions]
- 3. Planning and implementation of hill irrigation (3 hours)**
  - 3.1. Long Term Planning with Farmer's Participation
  - 3.2. Request Proposal for Project Assistance and Screening
  - 3.3. Stages of Project Study and Data Collection
  - 3.4. Detail Design and Implementation of Project
- 4. water availability and irrigation requirements (8 hours)**
  - 4.1. Flow Assessment Techniques Based on Data Availability (MIP, WECS & HSC)
  - 4.2. Extractable Flow for Irrigation
  - 4.3. Consumptive Use of Selected Cropping Pattern

- 4.4. Operational Water Requirements
- 4.5. Effective Rainfall Contribution with 80% reliability
- 4.6. Percolation Losses and Irrigation Efficiencies
- 4.7. Computation of Irrigation Requirements

- 5. Canal Irrigation in hills (12 hours)**
  - 5.1. Canal Intakes for Hill Irrigation**
    - 5.1.1. Design issues and construction materials for diversions; Suitable intakes and their locations;
    - 5.1.2. Design factors of bank intakes; Design of single orifice and bottom rack intakes
  - 5.2. Sediment Control for Hill Canals**
    - 5.2.1. Natural and artificial methods; Sediment control structures for hill canals;
    - 5.2.2. Design of gravel trap and settling basin; Estimation of sediment load in the absence of data
  - 5.3. Canals and Distribution Systems for Hill Irrigation**
    - 5.3.1. Nomenclature, layout and alignment of hill canals; Design of hill canals; Seepage and lining of hill canals;
    - 5.3.2. Characteristics of distribution systems and Layout pattern appropriate to hill irrigation; Structural components of the distribution system; Flow division structures and Operation of Saacho
  - 5.4. Escapes and Drop structures for Hill Canals**
    - 5.4.1. Need of escapes in hills; Suitable escapes for hills; Location of escapes in hills; Suitable drops in hills;
    - 5.4.2. Design of cascade and chute drops; Use of small drops to control water level and erosion
  - 5.5. Cross Drainage Structures for Hill Canals**
    - 5.5.1. Selection of suitable C/D structures in hills; Aqueducts, their advantages and disadvantages;
    - 5.5.2. Problems of aqueducts and prevention; Super passages, their advantages and disadvantages;
    - 5.5.3. Problems of super passages and prevention; Siphons and their disadvantages; Problems of siphons
    - 5.5.4. and prevention; Level crossings, their advantages and disadvantages; Inlets and Outlets
- 6. Sprinkler irrigation (5 hours)**
  - 6.1. Advantages and Suitability of Sprinkler for Hill Irrigation
  - 6.2. Limitations and Disadvantages of Sprinkler Irrigation
  - 6.3. Types and Components of Sprinkler System

- 6.4. Design Approach and Selection of Sprinklers
- 6.5. Design of a Portable Sprinkler System
- 6.6. Operation and Maintenance of Sprinkler System

**7. Drip or Trickle irrigation (5 hours)**

- 7.1. Advantages and Suitability of Drip for Hill Irrigation
- 7.2. Limitations and Disadvantages of Drip Irrigation
- 7.3. Types and Components of Drip System
- 7.4. Design Approach and Selection of Drips
- 7.5. Design of a Portable Drip System
- 7.6. Operation and Maintenance of Drip system

**8. Gabion structures for remote hill areas (2 hours)**

- 8.1. Advantages of Gabion Construction
- 8.2. Design Considerations for Gabion Structures
- 8.3. Characteristics of Fill Material

**Tutorials:**

- 1. Estimation of mean monthly and 80% reliable flows by MIP Method (1hour)
- 2. Estimation of mean monthly, low and 80% reliable flows by WECS/DHM Method (1 hour)
- 3. Estimation of mean monthly and 80% reliable flows by HSC method(1 hour)
- 4. Estimation of 80% reliable, effective monthly rainfall & half monthly values (2 hours)
- 5. Computation of Irrigation Requirements using Crpwat8 windows software (1 hour)
- 6. Design of single orifice & bottom rack intake (2 hours)
- 7. Design of gravel trap and settling basin (2 hours)
- 8. Estimation of sediment load in the absence of data (1 hour)
- 9. Design of cascade & chute drops (2 hours)
- 10. Design of a Portable Sprinkler System (1 hour)
- 11. Design of a Portable Drip System (1 hour)

**Assignments:**

Individual assignment on design of Sprinkler and Drip irrigation systems

**References:**

- 1. Hill Irrigation Engineering, Institute of Engineering, Pulchowk Campus, TU, Basil S. Jacob, The Ford Foundation, New Delhi, January 1995.
- 2. Design Manuals for Irrigation Projects in Nepal, M.1 to M.13, Sir M MacDonald & Partners Ltd, PDSP, UNDP, World Bank, DOI, February 1990.

**Evaluation Scheme:**

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

Chapters	Hours	Marks Distributions *
1	4	10
2	6	10
3	3	5
4	8	10
5	12	20
6	5	10
7	5	10
8	2	5
Total	45	80

\* There may be minor deviation in marks distribution.

## GROUNDWATER ENGINEERING CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### Course Objectives:

Groundwater Engineering is the first course in the physics of saturated flow in porous media with engineering applications. The course includes topics such as ground-water occurrence and Darcian flow, well hydraulics, pumping tests for finding aquifer parameters, overview of methods for groundwater explorations, tubewell construction methods and design, pump selection for lifting groundwater and economics of groundwater utilization. Moreover, the course gives an overview of groundwater resources of Nepal.

- 1. Occurrence of groundwater and its importance (5 hours)**  
Hydrological cycle and groundwater, Origin and age of groundwater, Groundwater basins, springs, and their types, Characteristics of groundwater its comparison and relation with surface water, Basic definitions of terms in groundwater hydrology with illustrations: Aquifer, Aquiclude, Aquifuge, Aquitard, Types of aquifer with illustrations- confined, unconfined, leaky, perched, Properties of soil/rock affecting groundwater flow: porosity, storage coefficient, specific yield
- 2. Fundamentals of Groundwater motion (8 hours)**  
Review of continuum approach and REV with specific reference to groundwater flow, Darcy's experiment and empirical expression of Darcy's law and its extension with 3-d generalization, Range of validity of Darcy's law and examples of non-Darcian flow in sub-surface, Definition of hydraulic conductivity, permeability (with their typical values), aquifer transmissivity, aquifer heterogeneity and anisotropy
- 3. Potential groundwater flow theory and Flow Net analysis (8 hours)**  
Plotting stream lines, equipotential lines, and flow net in groundwater, direction of groundwater flow from piezometric head observations, analysis of water table maps, Derivation of Laplace equation and its use in steady groundwater flow in isotropic and anisotropic media. Application of potential flow theory in steady one-dimensional flow in homogenous unconfined aquifer, horizontal galleries extending up to impervious rock

and aquifer with recharge; steady flow in a confine aquifer of constant and variable thickness.

- 4. Well hydraulics (4 hours)**  
Steady and unsteady radial flow in fully and partially penetrating non-leaky wells,  
Introduction of Multiple well systems and Interference of wells
- 5. Pumping test and estimation of aquifer properties (5 hours)**  
Use of Pumping tests in Groundwater hydrology, overview of types of pumping tests, This method for unsteady flow in unconfined, and confined non-leaky aquifers, Thiem's equilibrium formula for steady flow in unconfined aquifer, Jacob's time-drawdown and distance-drawdown methods for unsteady flow in non-leaky confined aquifer
- 6. Overview of Groundwater exploration (2 hours)**  
Objectives of groundwater exploration, Overview of methods of groundwater exploration, Water Winching, Geological, geophysical, electrical resistivity, seismic refraction methods
- 7. Water Well design (6 hours)**  
Classification of wells and tubewells, Design considerations in wells in confined and unconfined aquifer: well diameter, well depth, well screens( slot size, screen diameter, types and selection of screen), gravel pack design, Overview of design principle of collector wells and infiltration galleries
- 8. Pumps for groundwater lifting (4 hours)**  
a. Types of pumps, Overview of working principle and suitability of plunger, jet, deep-well vertical turbine, submersible, air-lift and centrifugal pumps, Factors to be considered in the selection of pump sets
- 9. Groundwater Resources of Nepal (3 hours)**  
Kathmandu Valley and Terai aquifers: Schematic zones showing water availability and development possibility

### Tutorials:

1. Fundamentals of Groundwater motion [4 hours]
2. Potential groundwater flow theory and Flow Net analysis [4 hours]
3. Well hydraulics [2 hours]
4. Pumping test and estimation of aquifer properties [2 hours]
5. Water Well design [3hours]

**Field visit and project works:**

Field visit to any drilling site or groundwater development project in Kathmandu or other areas. Students are also encouraged to visit drilling companies on their own to gain practical knowledge on hydrogeology. Also, assignment with project works related with ground water modeling is encouraged in the course.

**References:**

1. Groundwater. H. M. Raghunath, New Age International Publishers, 2nd Edition (1987)
2. Groundwater Hydrology, David Keith Todd, 2nd edition.
3. Hydraulics of Groundwater, Jacob Bear, McGraw-Hill, Inc.1979.
4. Handbook of Groundwater Development, John Wiley & Sons. U.S. Department of Interior, Bureau of Reclamation. 1995
5. Study of Groundwater Development: Strategies for Irrigation in the Terai, Volume 3. Groundwater, Groundwater Development Consultants (International) Limited, Cambridge, United Kingdom, 1987.
6. Groundwater Management Project in the Kathmandu Valley. Final report, Main report. Japan International Cooperation Agency. 1990.

**Evaluation Scheme:**

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

Chapter	Hours	Marks Distribution*
1	5	4
2	8	16
3	8	16
4	4	8
5	5	8
6	2	4
7	6	10
8	4	8
9	3	6
Total	45	80

\* There may be minor deviation in marks distribution.

## **Elective III**



## GIS AND REMOTE SENSING

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives

This course introduces principles, concepts and applications of Geographic Information Systems (GIS): a decision support tool for planners and managers of spatial information. Database development, manipulation and spatial analysis techniques for information generation will be taught. Students will have the scope of using GIS for applications in their related fields such as natural resource management, environment, civil engineering, agriculture, information system, etc will be discussed through miniproject and laboratory exercises.

- 1. Introduction and Overview of GIS and Software: [3 hours]**  
Definition of a GIS features and functions; why GIS is important; how GIS is applied; GIS as an Information System; GIS and cartography; contributing and allied disciplines; GIS data feeds; historical development of GIS.
- 2. GIS and Maps: [3 hours]**  
Map Projections and Coordinate Systems; Maps and their characteristics (selection, abstraction, scale, etc.); automated cartography versus GIS; map projections; coordinate systems; precision and error.
- 3. Spatial Data Models: [3 hours]**  
Concept of data model; raster data model; compression; indexing and hierarchical data structures; vector data model; topology; TIN data model.
- 4. Data Sources: [3 hours]**  
Data Input and Data Quality; Major data feeds to GIS and their characteristics; maps, GPS, images, databases; commercial data; locating and evaluating data; data formats; data quality; metadata.
- 5. Database Concepts: [3 hours]**  
Database concepts and components; flat files; relational database systems; data modeling; views of the database; normalization; databases and GIS.
- 6. Vector Analysis: [6 hours]**  
Data management functions; Data Analysis functions.

- 7. Spatial Analysis: [6 hours]**  
Spatial interpolation methods; raster analysis including topological overlay; Map calculations; statistics; integrated spatial analysis.
- 8. Surface Model: [3 hours]**  
DEM; slope; aspect; other raster functions.
- 9. River network Generation: [4 hours]**  
Flow direction; flow accumulation; river network; and watershed boundary delineation.
- 10. GPS: [4 hours]**  
Basic concept of GPS; How GPS works; DGPS; Errors in GPS; application.
- 11. Introduction to Remote Sensing: [4 hours]**  
Concept of Remote Sensing; Electro Magnetic Spectrum and windows; Spectral signature of different landuse; Introduction to different satellites; Resolutions in RS; Application of Remote Sensing.
- 12. Making Maps: [3 hours]**  
map functions in GIS; map design; map elements; choosing a map type; Exporting map in different format printing a map.

### Tutorials & Practical:

- Spatial database development [3 hours]
- Linking non-spatial and spatial database [3 hours]
- Projection [3 hours]
- Database editing and updating [6 hours]
- GPS data integration in GIS, [2 hours]
- Geo processing [3 hours]
- Spatial analysis [4 hours]
- River Analysis [2 hours]
- Map Layout [2 hours]
- Mini-project for GIS application. [8 hours]

### References:

- RaghunathJha (2000): Course Manual for GIS, IOE, Water Resources Engineering.*
- P.A. Burrough and R. A. McDonnell (1998): Principles of Geographical Information Systems, Oxford University Press.*
- J. Star and J. Estes (1990): Geographic Information Systems: An Introduction: Prentice Hall, Englewood Cliffs, N.J.*

4. *J. Lee, D.W.S. Wong (2002): Statistical Analysis with Arc View GIS: John Wiley and Sons, Inc., New York.*
5. *RaghunathJha (2000): Course Manual for GIS, IOE, Water Resources Engineering.*
6. *P.A. Burrough and R. A. McDonnell (1998): Principles of Geographical Information Systems, Oxford University Press.*
7. *J. Star and J. Estes (1990): Geographic Information Systems: An Introduction: Prentice Hall, Englewood Cliffs, N.J.*
8. *J. Lee, D.W.S. Wong (2002): Statistical Analysis with Arc View GIS: John Wiley and Sons, Inc., New York.*
9. *Daive J Maguire, Michael Goodchild and David W RHIND, 1999, Geographical Information Systems Vol 1: Principles, Longman Scientific Technical.*
10. *Laura Lang, 2000, Managing Natural Resources with GIS, ESRI, Redlands, CA.*

**Evaluation Scheme:**

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

Chapters	Hours	Marks Distribution *
1	3	6
2	3	6
3	3	6
4	3	6
5	3	6
6	6	10
7	6	10
8	3	6
9	4	6
10	4	6
11	4	6
12	3	6
Total	45	80

\* There may be minor deviation in marks distribution.

# ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

## Course Objective:

The objective of the course is to teach the students of civil engineering the functions of the various components of natural and manmade environment and their interaction with development activities. The course is aimed at imparting the knowledge of Environmental Impact Assessment (EIA) as relevant to various types of development projects. Students will be aware of prevailing practice of carrying out IEE/EIA studies for different governmental and non-governmental organizations, international donor agencies.

By the end of this course, students should be able to:

- i. Fully understand the IEE and EIA Regulatory Framework as specified in EPA and EPR, and the steps and process involved in IEE and EIA.
- ii. Conduct IEE/EIA in a team and be familiar with the principles and procedures of EIA, tools and techniques used in identification and analysis of impacts, suggest appropriate mitigation measures and prepare environmental management plans.

- 1. Introduction to Environmental Impact Assessment (EIA) [5 hours]**
  - 1.1. Emergence of EIA
  - 1.2. History of EIA in Nepal
  - 1.3. Definition and Types of EIA
  - 1.4. Project Types, impacts and their types
  - 1.5. The EIA Process and Project cycle
- 2. Screening and Initial Environmental Examination (IEE) [5 hours]**
  - 2.1. Objectives of Screening
  - 2.2. Screening procedure
  - 2.3. Initial Environmental Examination
  - 2.4. Methods for IEE
- 3. Scoping and Preparation of Terms of Reference (ToR) [5 hours]**
  - 3.1. Objectives of Scoping
  - 3.2. Scoping Process
  - 3.3. Terms of Reference and its main components

- 4. Establishing the Environmental baseline [5 hours]**
  - 4.1. The Environmental setting
  - 4.2. Purpose of baseline data
  - 4.3. Methods of data collection
  - 4.4. Importance of baseline data
- 5. Impact Identification, Prediction and Evaluation Techniques [10 hours]**
  - 5.1. Methods of impact identification
  - 5.2. Methods of impact prediction
  - 5.3. Impact evaluation techniques
  - 5.4. Numerical on impact prediction and evaluation
- 6. Environmental Protection Measures (EPMs) [6 hours]**
  - 6.1. Introduction
  - 6.2. Types of mitigation measures
  - 6.3. Implementation of EPMs
- 7. Management of EIA process [9 hours]**
  - 7.1. Environmental Management Plan
  - 7.2. Environmental Monitoring
  - 7.3. Environmental Auditing
  - 7.4. EIA Report Review and Decision Making
  - 7.5. Stakeholder Consultation and Public Participation

## Tutorials:

- 1. Introduction to EIA**  
Definitions, History of EIA, Types of EIA, EIA process & Project cycle
- 2. Screening & IEE (1 hour)**  
Definitions, Objectives & Need of screening, Screening criteria & procedures, Methods for IEE
- 3. Scoping & Preparation of ToR (1 hour)**  
Definitions, Objectives of scoping, scoping procedure, ToR& its main components
- 4. Establishing the environmental baseline (1 hour)**  
Definition, Purpose of baseline information, data collection methods, importance of baseline data
- 5. Impact identification, prediction & evaluation techniques (6 hours)**  
Importance of impact identification and prediction, Evaluation techniques, Numerical on impact prediction
- 6. Environmental Protection Measures (1 hour)**  
Definitions, Types of mitigation measures, Implementation of EPMs,
- 7. Management of EIA Process (3 hours)**

**Practical / Project Work.**

Environmental management plan, Environmental monitoring plan, Environmental auditing plan, Review of EIA Report, Process of stakeholder consultation & public participation

**Reference:**

1. Canter, Larry W., Environmental Impact Assessment, McGraw Hill, 1996
2. Upreti, B. K.: Environmental Impact Assessment: process and practice. Published by UttaraUprety, Koteshwor, Kathmandu, 2003
3. IUCN/Nepal: EIA Training Manual for Professionals and Managers. Published by IUCN/Nepal, 2003

**Examination Scheme:**

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

Chapters	Hours	Marks Distribution*
1	5	10
2	5	8
3	5	8
4	5	8
5	10	21
6	6	9
7	9	16
Total	45	80

\* There may be minor deviation in marks distribution.

# CONSTRUCTION SAFETY MANAGEMENT

CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

## Course Objective:

To provide basic knowledge on accidents and their impacts on construction; safety legislations and rules to be followed in construction; site safety practices to be followed during construction practices; human factors; ergonomics and cost of accidents and make aware on role of various parties for site safety management.

- 1. Introduction [3 hours]**
  - 1.1. Accidents
  - 1.2. Nature and Causes of Accidents
  - 1.3. Impact of Accidents
  - 1.4. Evolution of Safety Concepts
- 2. An Overview of Construction Safety [4 hours]**
  - 2.1. Construction Safety
  - 2.2. Current Situation
  - 2.3. Organizational Aspect
  - 2.4. Behavioral Aspect
- 3. Important Safety Rules [4 hours]**
  - 3.1. Accident Reporting
  - 3.2. Storage of Materials
  - 3.3. Atmosphere in Confined Place
  - 3.4. Prevention from Drowning
  - 3.5. Fire Prevention and Protection
  - 3.6. First Aid and Medical Care
  - 3.7. Personal Protective Equipments
- 4. Site Safety Management [4 hours]**
  - 4.1. Workplace and Equipment
  - 4.2. Structures and Equipments
  - 4.3. Working Platforms
  - 4.4. Safety Organizations

- 5. Safety in Construction Operations [6 hours]**
  - 5.1. Planning For Safety
  - 5.2. Excavation
  - 5.3. Blasting
  - 5.4. Tunneling
  - 5.5. Building Works
  - 5.6. Scaffolding
  - 5.7. Lifting
  - 5.8. Use of Electricity
- 6. Safety in the Use of Construction Equipment [4 hours]**
  - 6.1. Psychology of Construction Workers
  - 6.2. Rights and Obligation of Parties
  - 6.3. Health of Equipment Operators
  - 6.4. Vehicles
  - 6.5. Cranes
  - 6.6. Lifting Gears
  - 6.7. Temporary Power Supply
- 7. Safety and Economy [3 hours]**
  - 7.1. Direct Costs of Accidents
  - 7.2. Indirect Cost of Accidents
  - 7.3. Cost of Safety Programs
  - 7.4. Safety Cost Optimization.
- 8. Psychological Aspect and Ergonomics [3 hour]**
  - 8.1. Carelessness
  - 8.2. Related Physical Factor
  - 8.3. Other Factors
  - 8.4. The Shop Environment and Safe Behavior
  - 8.5. Job Stress and Its Effect
  - 8.6. Human Factors, Biomechanics and Ergonomics
- 9. Human Factors in Construction Safety [2 hours]**
  - 9.1. Employee Selection
  - 9.2. Placement
  - 9.3. Motivation: Awareness and Training
- 10. Personal Protection [4 hours]**
  - 10.1. Eye Protection
  - 10.2. Finger, Arm and Hand Protection
  - 10.3. Foot and Leg Protection
  - 10.4. Noise Safeguard

- 10.5. Head Protection
- 10.6. Safety Belt

**11. Safety Legislation in Construction Industry [4 hours]**

- 11.1. Safety Codes Applicable to Construction Industry
- 11.2. ILO Standards
- 11.3. OSHA regulations
- 11.4. Health and Safety Provision in Nepal
- 11.5. Contract Conditions on Safety in Civil Works Projects

**12. Safety Management: Role of Various Parties [4 hours]**

- 12.1. Employers
- 12.2. Designers
- 12.3. Supervisors
- 12.4. Manufacturers/Dealers
- 12.5. Workers/employees
- 12.6. Motivating management
- 12.7. Contractual provisions

**Tutorials:**

1. Safety rules implementation
2. Accident Analysis
3. Safety cost Analysis and Optimization

**Field Visit:**

Minimum of one day Field Visit of Construction Projects to observe site safety practices is required

**References:**

1. Grimaldi John. V. and Simonds R.H., "Safety Management" 1991, All India Traveller Book Seller, Fifth Edition.
2. Vaid, K.N. "Construction Safety Management", NICMAR Publication, 1988.

**Evaluation Scheme:**

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

Chapters	Hours	Marks distribution *
1	3	6
2	4	6
3	4	8
4	4	8
5	6	10
6	4	8
7	3	5
8	3	5
9	2	3
10	4	5
11	4	8
12	4	8
Total	45	80

\* There may be minor deviation in marks distribution.

## DISASTER RISK MANAGEMENT CE ...

**Lecture : 3**  
**Tutorial : 1**  
**Practical : 1.5**

**Year : IV**  
**Part : II**

### Course Objectives:

The course provides practical information on Disaster Risk Management. This course deals with Disaster risk reduction and disaster risk management and students will learn all three cycle of disaster management and its activities. Student will be able to deal with pre and post disaster cycle and planning on disaster risk reduction. The students will also learn DRR terminology and will learn the tools and techniques of assessment and planning for both pre and post disaster.

- |   |                   |
|---|-------------------|
| <b>1. Introduction Disaster Risk Management</b>               | <b>[4 hours]</b>  |
| <b>2. Terminology on DRR</b>                                  | <b>[2 hours]</b>  |
| <b>3. Hazard, Risk and Vulnerabilities</b>                    | <b>[6 hours]</b>  |
| 3.1. Physical dimensions                                      |                   |
| 3.2. Social dimensions  |                   |
| 3.3. Economic dimensions                                      |                   |
| 3.4. Disaster and emergencies – its types and level of impact |                   |
| <b>4. Disaster Management Cycle</b>                           | <b>[12 hours]</b> |
| 4.1. Pre Disaster Management                                  |                   |
| 4.1.1. Preparedness   |                   |
| 4.1.2. Prevention   |                   |
| 4.1.3. Mitigation   |                   |
| 4.2. Post Disaster Management                                 |                   |
| 4.2.1. Emergency Response                                     |                   |
| 4.2.2. Recovery   |                   |
| 4.2.3. Reconstruction/Rehabilitation                          |                   |
| <b>5. Cluster Approach</b>                                    | <b>[6 hours]</b>  |
| <b>6. Assessment tools</b>                                    | <b>[6 hours]</b>  |
| <b>7. Risk Reduction approach, strategies and polices</b>     | <b>[4 hours]</b>  |

**8. Risk analysis technique** **[5 hours]**

### Tutorials & Practicals

1. Case study of recent disaster and its management
2. Project work - Hazard on districts
3. Project work - post disaster management for given scenario

### References

1. At Risk: Natural Hazards, people's Vulnerability and Disasters, Wisner et al, 2004, Routledge
2. Manual on International Law and Standards Applicable in Natural Disaster Situations, International Development Law Organisation, 2008 <http://www.idlo.int>
3. Human Rights and Natural Disasters, Operational Guidelines and Field Manual on Human Rights Protection in Situations of Natural Disaster, Brookings-Bern Project on Internal Displacement. [http://www.brookings.edu/projects/idp/2006\\_naturaldisasters.aspx](http://www.brookings.edu/projects/idp/2006_naturaldisasters.aspx)
4. Guidelines for assessment in emergencies March 2008, ICRC, IFRC
5. *Sphere Humanitarian Charter: Common Standard 2*
6. <http://www.logcluster.org/tools/lca>

### Evaluation scheme:

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

Chapters	Hours	Marks Distribution *
1	4	4
2	2	4
3	6	10
4	12	30
5	6	10
6	6	10
7	4	4
8	5	8
<b>Total</b>	<b>45</b>	<b>80</b>

\* There may be minor deviation in marks distribution.

## PROCUREMENT MANAGEMENT CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

- To introduce the concept of Procurement, Procurement Planning, Methods and Types of Procurement
- To make aware on the present procurement rules followed in Nepal
- To provide knowledge on dispute resolution that arises during contract
- To introduce on procurement guidelines followed by different Agencies working in Nepal
- To make aware on Technical Audit Process that is followed in Nepal.

### 1. Concept of Procurement [4 hours]

- 1.1. Definition
- 1.2. Difference between Public and Private Procurement
- 1.3. Procurement of Works, Goods and Services, and Consulting Services
- 1.4. Procurement Cycle

### 2. Procurement Planning [4 hours]

- 2.1. Plan and Planning
- 2.2. Need and Importance of Procurement Planning\
- 2.3. Master Procurement Plan
- 2.4. Planning and Initiation of Individual Requirements
- 2.5. Implementation Arrangements

### 3. Methods of Procurement [6 hours]

- 3.1. Open Competitive Bidding
- 3.2. Limited Bidding
- 3.3. Sealed Quotations
- 3.4. Direct Procurement
- 3.5. Community Participation
- 3.6. Force Account

### 4. Types of Procurement [6 hours]

- 4.1. Unit Price Works (BOQ) contract
- 4.2. Lump Sum Contract
- 4.3. Cost Reimbursable Contract

- 4.4. Time and Material Contract
- 4.5. Design and Build Contract
- 4.6. BOOT, BOT Contract

### 5. Present Procurement Rules and Regulations (Procurement of Consulting Services) [4 hours]

- 5.1. Advertising, EoI, ToR, and RFP Preparation
- 5.2. Technical and Financial Evaluation
- 5.3. Negotiation and Award of Contract

### 6. Present Procurement Rules and Regulations (Procurement of Works and Goods) [6 hours]

- 6.1. Bid Document Preparation including technical specification, Evaluation Criteria,
- 6.2. Sale/Issue of Bid Documents, Pre-bid Conference, Bid Opening, Bid Examination, Bid Evaluation and Award of Contract
- 6.3. Nepal Specific Contract Management

### 7. Contract Management [6 hours]

- 7.1. Dispute: Causes and Resolutions
- 7.2. Extension of Contract
- 7.3. Termination of Contract
- 7.4. Closing of Contract

### 8. Introduction to Guidelines [4 hours]

- 8.1. FIDIC Documents
- 8.2. ADB Guidelines
- 8.3. WB Guidelines
- 8.4. Other Donor Guidelines

### 9. Technical Audit [5 hours]

- 9.1. Concept of Technical Audit
- 9.2. Status of Technical Audit in Nepal
- 9.3. Technical Audit Process
- 9.4. Performance Evaluation

### Tutorials

1. Prepare procurement Master Plan
2. Prepare typical tender notice
3. Bid-evaluation



**Practical**

1. Prepare contract document
2. Field visit for technical audit

**Project work**

At least five case studies on Procurement will be discussed in classes.

**Evaluation Scheme:**

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

Chapters	Hours	Marks Distribution *
1	4	8
2	4	8
3	6	10
4	6	10
5	4	8
6	6	10
7	6	10
8	4	8
9	5	8
Total	45	80

\* There may be minor deviation in marks distribution.

## TIME SERIES ANALYSIS

CE ...

Lecture : 3  
Tutorial : 1  
Practical : 1.5

Year : IV  
Part : II

### Course Objectives:

To enhance the students understanding and the possibilities and limitation of different types of time series models through lectures and practical model application..

- 1. Introduction (2 hours)**  
Stochastic processes and time series, Time series modeling, Physical basis of time series modeling in hydrology, Applicability.
- 2. Characteristics of hydrologic series (2 hours)**  
Type of hydrologic series, General properties of hydrologic time series.
- 3. Statistical principles and techniques for time series modeling (8 hours)**  
Probability function and distribution function, Derived distributions, Chebyshev's Inequality, moment generating function, normal distribution, Central limit theorem, Estimation of the parameters of the distribution; Methods of moments, Method of maximum likelihood, selection of distribution.
- 4. Autocorrelation Analysis (8 hours)**  
Classification of time series, Components of time series, Method of investigation, estimation of the auto-correlation coefficient, Correlogram of an independent process
- 5. Time Series Models (12 hours)**  
Moving average process, Auto regressive process, Goodness of fit for annual AR models; Test on the assumptions of the model, Comparison of the historical and model correlograms, Test of Parsimony of parameters, Generation and forecasting using annual AR models; Thomas-fiering model; Auto regressive moving average process, application in flood forecasting system, Autoregressive integrated moving average process,
- 6. Seasonal models (8 hours)**  
Univariate seasonal models, Daily flow model, spectral analysis; introduction, Line spectrum.

- 7. Generation of random variates (5 hours)**  
Uniformly distributed random numbers; Mid square technique, Mid-product technique, Mixed congruential method, testing the random numbers sequence, generation of normal random numbers; The inverse transformation method, the central limit theorem method, Box-muller method.

### Tutorials:

1. Statistical principles and Techniques [2 hours]
2. Auto Correlation Analysis [4 hours]
3. AR models, Thomas Fiering models [5 hours]
4. ARMA , ARIMA [2 hours]
5. Generation of Random variates [2 hours]

### Practical:

1. Non seasonal modeling of River system of Nepal
2. Daily flow modeling of River System of Nepal

### References:

1. **Stochastic Hydrology**, P.Jayarami Reddy, Laxmi Publications, New Delhi
2. **Applied Modelling of Hydrologic Time Series**, Salas, Delleur, Yevjevich and Lane, Water Resources Publications, Colorado, USA

### Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	8
2	2	8
3	8	12
4	8	12
5	12	20
6	8	12
7	5	8
Total		

\* There may be minor deviation in marks distribution.