BACHELOR
IN
CIVIL ENGINEERING

Year : I **Part : I**

Teaching Schedule								Examination Scheme							
								Theory			Practical				
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		Total	Remark
									Duration hours	Marks		Duration hours	Marks		
1	SH 101	Engineering Mathematics I	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 103	Engineering Chemistry	3	3	1	3	7	40	3	60	25	-	-	125	
3	CT 101	Computer Programming	3	3	1	3	7	40	3	60	50	-	-	150	
4	EE 103	Basic Electrical and Electronics Engineering	3	3	1	1.5	5.5	40	3	60	25	-	-	125	
5	CE 101	Engineering Mechanics	4	4	2	-	6	40	3	60	-	-	-	100	
6	CE 102	Engineering Geology I	2	2	-	1	3	20	1.5	30	25	-	-	75	
7	CE 103	Civil Engineering Materials	2	2	-	1	3	20	1.5	30	25	-	-	75	
		Total	**20**	**20**	**7**	**9.5**	**36.5**	**240**	**-**	**360**	**150**	**-**	**-**	**750**	

Year : I **Part : II**

Teaching Schedule								Examination Scheme							
								Theory			Practical				
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		Total	Remark
									Duration hours	Marks		Duration hours	Marks		
1	SH 151	Engineering Mathematics II	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 152	Engineering Physics	4	4	1	2	7	40	3	60	25	-	-	125	
3	ME 158	Engineering Drawing	2	2	-	4	6	20	3	30	50	-	-	100	
4	CE 151	Strength of Materials	3	3	1	1	5	40	3	60	25	-	-	125	
5	CE 152	Engineering Geology II	2	2	-	1	3	20	1.5	30	25	-	-	75	
6	CE 153	Engineering Survey I	3	3	1	4	8	40	3	60	50	-	-	150	
		Total	**17**	**17**	**5**	**12**	**34**	**200**	**-**	**300**	**175**	**-**	**-**	**675**	

ENGINEERING MATHEMATICS I

SH 101

Lecture : 3 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
To equip the students with the essential mathematical skills and techniques that are relevant to the engineering fields and enable them to solve engineering problems using mathematical methods.

1 Derivatives and its Applications (10 hours)

1.1 Review of derivative and differentiability, mean value theorems with interpretations
1.2 Indeterminate forms, types and their real life examples, L-Hospital's Rule
1.3 Power series of single valued functions
  1.3.1 Taylor's series
  1.3.2 Maclaurin's series
1.4 Asymptotes to Cartesian and Polar curves
1.5 Pedal equation to Cartesian and Polar curves
1.6 Curvature and radius of curvature for Cartesian curves

2 Antiderivatives and its Applications (11 hours)

2.1 Review of definite and indefinite integrals
2.2 Differentiation under integral sign
2.3 Improper integrals
2.4 Application of Beta and Gamma functions
2.5 Area, arc length, volume and surface of revolution in plane for Cartesian curves
2.6 Centroid and moment of inertia under area of curve

3 Ordinary Differential Equations and its Applications (10 hours)

3.1 Review of: Order, degree, solution of first order first degree differential equations by variable separation method and solution of homogeneous equations.
3.2 Linear differential equation and equations reducible to linear differential equation of first order Bernoulli’s equation, modeling electric circuit
3.3 First order and higher degree differential equations; Clairaut’s form

3.4 Linear second order differential equations with constant coefficient and variable coefficients reducible to constant coefficients, Cauchy's equations and modeling mass spring system

3.5 Application in physical sciences and engineering

4 Plane Analytic Geometry (4 hours)

4.1 Transformation of coordinates: Translation and Rotation

4.2 Equation of conic in Cartesian and polar form, identification of conics

5 Three dimensional geometry (10 hours)

5.1 The Straight line: symmetrical and general form

5.2 Coplanar lines

5.3 Shortest Distance

5.4 Sphere: General equation, plane section by planes, tangent planes

5.5 Introduction to right circular cone and right circular cylinder

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Derivatives and its Applications
2. Antiderivatives and its Applications
3. Ordinary Differential Equations and its Applications
4. Plane Analytic Geometry
5. Three dimensional geometry

Reference

1. Jeffery A., (2001), Advanced Engineering Mathematics (1st ed.), Academic Press.
2. O'Neill, P.V., (2003), Advanced Engineering Mathematics (5th ed.), Thomson Learning.
3. Kreyszig , A. (1993), Advanced engineering Mathematics (7th ed.), John Wiley & Sons.
4. Sastry S.S. (2008), Engineering Mathematics Volume I and II (4th ed.). PHI India.
5. Wylie C. and Barrett L.(1995), Advanced Engineering Mathematics (6th ed.), McGraw-Hill College.
6. Thomas, T. and Finny, R. (1984), Calculus and Analytic Geometry (6th ed.), Addison-Wesley.

ENGINEERING CHEMISTRY

SH 103

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

Course Objectives:
To develop the basic concepts of physical chemistry, inorganic chemistry, analytical chemistry, environmental chemistry, green & sustainable chemistry, nano chemistry, polymer chemistry and organic chemistry relevant to the different disciplines of engineering.

1 Electrochemistry and Buffer (8 hours)

- 1.1 Electrochemistry
  - 1.1.1 Introduction
  - 1.1.2 EMF of galvanic cell, Nernst equation
  - 1.1.3 Polarization and Overpotential
  - 1.1.4 Butler-Volmer equation and Tafel plots
- 1.2 Electrode processes and mechanisms
  - 1.2.1 Charge transfer processes at electrodes
  - 1.2.2 Mass transfer and diffusion in electrochemical systems
- 1.3 Industrial and applied electrochemistry
  - 1.3.1 Batteries: Lead acid and lithium ion
  - 1.3.2 Solar-photovoltaic cell, fuel cell
  - 1.3.3 Corrosion
- 1.4 Buffer, buffer range, buffer capacity and buffer solution and its applications

2 Catalyst and Catalysis (4 hours)

- 2.1 Definition and types
- 2.2 Design and criteria
  - 2.2.1 Structure-activity relationships
  - 2.2.2 Selection criteria of catalyst
- 2.3 Photocatalysis and electrocatalysis
- 2.4 Catalysis for energy and environmental applications
  - 2.4.1 Catalytic conversion of fossil fuels
  - 2.4.2 Renewable energy catalysts
  - 2.4.3 Catalyst for pollution control

3 Analytical Techniques and their Applications (6 hours)

3.1 Chromatography
3.2 Mass spectroscopy
3.3 X – ray diffraction (XRD)
3.4 UV – visible spectroscopy
3.5 Infrared – spectroscopy (IR)
3.6 Nuclear magnetic resonance spectroscopy (NMR)

4 Metal Complexes, Rare Earth Elements and Metal alloys (6 hours)

4.1 Complexes
  4.1.1 Introduction and Werner's theory
  4.1.2 Geometry of complex by VBT and its applications
  4.1.3 Crystal Field Theory: Principle and applications
4.2 Rare earth elements: Introduction and applications
4.3 Metallic alloys and applications

5 Sustainable Chemistry (7 hours)

5.1 Green chemistry: Introduction and principles
5.2 Water chemistry
  5.2.1 Importance of water quality standards
  5.2.2 Degree of hardness, scale formation in boiler and softening of hard water
  5.2.3 Water pollution with reference to turbidity, COD, BOD, heavy metals, radioactive substances, and plastic
  5.2.4 Industrial wastewater and its treatment
5.3 Air pollution
  5.3.1 Particulate matter, SOx, NOx, GHGs, VOCs, their impacts and remedies
5.4 Waste management
  5.4.1 Segregation and management of solid waste
  5.4.2 Management of biodegradable waste into energy
  5.4.3 E-waste and its management

6 Nanoscience and Nanotechnology (3 hours)

6.1 Introduction and types of nano materials (0-, 1-, 2-, and 3- dimensional)
6.2 Nanoparticles, Nanofibers, Nanowires, Carbon nanotubes, graphene, Mxene, quantum dots, and their uses
6.3 Preparation of nanomaterials

7 Engineering Materials (7 hours)

7.1 Polymers
- 7.1.1 Natural and synthetic, organic and inorganic, conducting and non-conducting
- 7.1.2 Types of polymerizations: Addition and condensation polymerization
- 7.1.3 Preparation and applications of – Epoxy resin, polyurethane, Kevlar, polycarbonate, polymethyl methacrylate, polyacrylonitrile, silicones; phosphorus based polymer, Sulphur based polymer
- 7.1.4 Conducting polymers: Synthesis and application
- 7.1.5 Composite: Fiber reinforced polymer
- 7.1.6 Natural polymers: cellulose, chitin, chitosan, collagen

7.2 Cement: Hydration and setting chemistry of cement

8 Explosives, Lubricants and Paints (4 hours)

8.1 Explosives
- 8.1.1 Types of explosives: Primary, low and high explosives
- 8.1.2 Preparation and applications of TNT, TNG, Nitrocellulose and Plastic explosives

8.2 Lubricants: Introduction, function and classification

8.3 Paints
- 8.3.1 Introduction, requisites, types and applications
- 8.3.2 Environmental and health impact

Laboratory

1. Determine of total, temporary and permanent hardness of water sample using complexometric titration.
2. Determine the alkalinity of water sample A and B by double indicator titration.
3. Estimate the amount of residual chlorine in water by iodometric titration.
4. Prepare the standard buffer solution (acidic or basic) and measure the approximate pH of given unknown solution by using Universal Indicator.
5. Compare the cleansing power of two sample of detergents by determining the reduction they cause in surface tension of water.
6. Construct Daniell cell and study the variation of cell potential with concentration.
7. To separate the pigments through the process of paper / thin layer chromatography.
8. Determination of total iron in ground water using spectrophotometer technique.
9. Determination of amount of copper and iron in a given mixture solution by K2Cr2O7 titration.
10. To prepare Cross – linked polymer by condensation polymerization method.
11. Standardize Potassium Permanganate Solution and use it to estimate the amount of Iron and determine the Percentage purity in the sample of Ferrous salt Solution.
12. Prepare Ni-DMG Complex and to estimate the amount of Nickel in it.

Reference

1. S.H. Maron and C. Prutton, Principles of Physical Chemistry, 4th Edition, Oxford and IBH Pub. Co., 1992.
2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, John Wiley and sons, Inc., 2007.
3. R.D. Madan & Satya Prakash, Inorganic Chemistry, S. Chand & Company Ltd., 1994.
4. S. Bahl, G.D. Tuli & A. Bahl, Essential of Physical Chemistry, Revised Multicolor Edition, S. Chand & Co. Ltd., New Delhi, 2009.
5. A.K. Bhagi & G.R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th and 7th Edition, Prentice – Hall of India Pvt. Ltd., 2008.
6. R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th and 7th Edition, Prentice – Hall of India Pvt. Ltd., 2008.
7. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education 2008.
8. B.S. Murthy, P. Shankar, Baldev R, B. B. Rath & James Murday, Textbook of Nanoscience and Nanotechnology, Series in Metallurgy and Materials Science, Baldev Raj (Ed.), Universities Press Private Hyderabad, India, 2012.. Chatwal, Environmental Chemistry, Himalaya Publishing House, Mumbai.

COMPUTER PROGRAMMING

CT 101

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

Course Objectives:

The primary goal of this course is to provide students with a solid foundation in the principles of programming and to impart practical skills in the C programming language. This course ensures that students comprehend the fundamental concepts of variables, data types, control structures, and functions within the context of C. Advanced topics such as pointers, structures, file handling and the Standard C Library are explored to broaden students' programming capabilities. Also, through project-based assessments and evaluations, students apply their knowledge to real-world scenarios, fostering creativity and project development skills.

1 Introduction to Computer Programming (3 hours)

1.1 Definition of a computer program and programming language
1.2 Types and Generations of Programming Languages
1.3 Problem-Solving using a Computer
  1.3.1 Problem Analysis
  1.3.2 Algorithm and Flowchart
  1.3.3 Programming
  1.3.4 Compilation, Linking and Execution
  1.3.5 Debugging and Testing
  1.3.6 Documentation

2 Overview of C Programming (3 hours)

2.1 Introduction to C programming
2.2 History and Importance of C
2.3 C Headers and Library Functions
2.4 Basic Structure of a C Program
2.5 Preprocessor Directives
2.6 Tokens in C (Character set, Keywords and Identifiers)
2.7 Type Casting (Implicit and Explicit)
2.8 Data Types, Variables and Constants
2.9 Compiler and IDE for C Programming

3 Operators and Expressions (4 hours)

- 3.1 Introduction to Operators and Expressions
- 3.2 Arithmetic, Relational and Logical Operators
- 3.3 Assignment, Increment and Decrement Operators
- 3.4 Conditional, Bitwise and Special Operators
- 3.5 Comma Operator, size of Operator
- 3.6 Evaluation and Type Conversion in Expressions
- 3.7 Operator Precedence and Associativity

4 Input and Output (3 hours)

- 4.1 Introduction to data I/O in C
- 4.2 Unformatted I/O
  - 4.2.1 Character I/O
  - 4.2.2 String I/O
- 4.3 Formatted I/O
  - 4.3.1 Control String (flags, field width, precision, and specifier)
  - 4.3.2 Formatted I/O (scanf(), printf())

5 Control Structures (8 hours)

- 5.1 Introduction to Simple and Compound Statement
- 5.2 Sequential Statement
- 5.3 Branching Statement
  - 5.3.1 Simple if Statement
  - 5.3.2 if-else Statement
  - 5.3.3 Nested if-else Statement
  - 5.3.4 else-if Ladder
  - 5.3.5 switch Statement
  - 5.3.6 go to statement
- 5.4 Looping Statement
  - 5.4.1 for loop
  - 5.4.2 while loop
  - 5.4.3 do while
  - 5.4.4 Nested loop
- 5.5 Loop Interruption
  - 5.5.1 break
  - 5.5.2 continue

6 Array and Pointer (7 hours)

6.1 Introduction to an Array
6.2 One-dimensional Array
6.3 Two-dimensional Array
6.4 Multidimensional Array
6.5 Introduction to String
6.6 String Handling Functions
6.7 Definition of a Pointer
6.8 Pointer Declaration
6.9 Pointer Arithmetic
6.10 Relationship between Pointer and Arrays

7 User-defined Functions (6 hours)

7.1 Introduction to Function
7.2 Advantages of Function
7.3 Elements of User-defined Function
  7.3.1 Function Definition
  7.3.2 Function Prototype
  7.3.3 Function Parameters
7.4 Storage Class
7.5 Scope Rules
7.6 Category of Functions
  7.6.1 Functions with no arguments and no return values
  7.6.2 Functions with arguments and no return values
  7.6.3 Functions with arguments and return values
  7.6.4 Functions with no arguments and return values
7.7 Recursive functions
7.8 Function Call by Values and Reference
7.9 Passing Array and String to Function

8 Structures (5 hours)

8.1 Defining a Structure
8.2 Declaring and Accessing Structure Elements
8.3 Initializing Structure
8.4 Array of Structure
8.5 Array as member to Structure
8.6 Pointer as member to Structure
8.7 Structure as a member to Structure
8.8 Passing and Returning Structures to/from Function

9 File management (4 hours)

- 9.1 Introduction
- 9.2 Binary and Text File in C
- 9.3 File Opening Modes
- 9.4 Defining, Opening and Closing File
- 9.5 Input-output operations on files
  - 9.5.1 Character I/O (fputc(), fgetc())
  - 9.5.2 String I/O (fgets(), fputs())
  - 9.5.3 Formatted I/O (fscanf(), fprintf())
  - 9.5.4 Record I/O (fwrite(), fread())
- 9.6 Overview of Random File Access
- 9.7 Error handling

10 Recent Trends in Programming (2 hours)

- 10.1 Introduction to Object Oriented Programming (OOP)
- 10.2 Definitions of Class, Method and Object in OOP
- 10.3 Difference between Procedure Oriented and OOP
- 10.4 Overview of other High Level Programming Languages

Laboratory

1. Lab 1: Introduction and Demonstrations of projects written in C
2. Lab 2: Formatted and Unformatted Input/output in C
3. Lab 3: Branching in Control Structure
4. Lab 4: Looping in Control Structure
5. Lab 5: Array in C
6. Lab 6: String in C
7. Lab 7: Pointers in C
8. Lab 8: User Defined functions in C
9. Lab 9: Structure in C
10. Lab 10: File handling in C
11. Group project on C maximum 4 students in a group at the end of the course.

Reference

1. Robert Lafore, “C Programming Using Turbo C++”, SAMS publication
2. E. Balagurusamy, “Programming in Ansi C”, McGraw Hill Education
3. Bryons S. Gotterfried, “Programming with C”, TMH ….

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

EE 103

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objectives:
The course aims to provide a comprehensive understanding of electrical engineering basics, encompassing circuits, components, and related laws, emphasizing safety in installations. It also seeks to familiarize students with electrical machines, semiconductor devices, and initiate them into applications in digital electronics.

1 Fundamentals of Electrical and Electronics Circuits (12 hours)

- 1.1 Current and Potential
- 1.2 Circuit Components: Source, Conductor, Resistor, Inductor, Capacitor
- 1.3 Ohms Law
- 1.4 Series and Parallel Circuits
- 1.5 Kirchhoff's Law and its application
  - 1.5.1 Nodal Analysis
  - 1.5.2 Mesh Analysis
- 1.6 Introduction to AC Circuits and Parameters
  - 1.6.1 Generation of AC Voltage
  - 1.6.2 Waveforms
  - 1.6.3 Average value
  - 1.6.4 RMS Value
- 1.7 Single Phase AC Circuit Analysis with R, RL, RC and RLC Load
- 1.8 Three phase AC Circuits
  - 1.8.1 Waveform and Advantage
  - 1.8.2 Line and Phase Quantities in Star and Delta Connection
  - 1.8.3 Voltage & current computation in Balance Circuits
  - 1.8.4 Power Measurement in Three Phase Circuits

2 Electrical Machines (14 hours)

- 2.1 Faraday's Law of Electromagnetic Induction
- 2.2 Dynamically and Statically Induced EMFs
- 2.3 Transformer
  - 2.3.1 Introduction of Single-Phase Transformer
  - 2.3.2 Working Principle of Transformer
  - 2.3.3 Components of Transformer
  - 2.3.4 Transformation Ratio
  - 2.3.5 EMF Equation of Transformer
  - 2.3.6 Types of Transformers
  - 2.3.7 Load and No-Load Operation
  - 2.3.8 Ideal and Practical Transformer
  - 2.3.9 Losses and Efficiency
  - 2.3.10 Applications
- 2.4 Three phase induction motor
  - 2.4.1 Construction
  - 2.4.2 Rotating Magnetic Field
  - 2.4.3 Working Principle
  - 2.4.4 Direction of Rotor and Slip
  - 2.4.5 Types of Rotors
  - 2.4.6 Standstill and Running Condition
  - 2.4.7 Modes of Operation
  - 2.4.8 Torque Equations
  - 2.4.9 Torque-Slip Characteristics
  - 2.4.10 Applications
- 2.5 DC Motors
  - 2.5.1 Construction
  - 2.5.2 Working Principle
  - 2.5.3 Back EMF and its Significance
  - 2.5.4 Power Torque Relationships
  - 2.5.5 Types of Motors
  - 2.5.6 Losses and Efficiency
  - 2.5.7 Applications
- 2.6 Synchronous Generator
  - 2.6.1 Construction
  - 2.6.2 Working Principle
  - 2.6.3 EMF Equation
  - 2.6.4 Applications

3 Introduction to Electronics Engineering (11 hours)

3.1 Semiconductor and Doping
3.2 Introduction to Diode
3.3 Characteristics of PN junction diode
3.4 Half-wave and full-wave rectifiers
3.5 Zener Effect
3.6 Zener diode and its characteristics
3.7 Zener diode as a Voltage regulation
3.8 Bipolar junction transistor
  3.8.1 Biasing
  3.8.2 BJT as a switch
  3.8.3 BJT as an amplifier
3.9 Introduction to Digital Electronics
3.10 Logic Gates and Boolean Algebra

4 Electrical Installations (8 hours)

4.1 Consumer Power Supply System
4.2 Overview of Electrical Wiring Components: Switches, Sockets, and Distribution Boards
4.3 Protective devices, their constructions and Sizing,
  4.3.1 Fuse
  4.3.2 MCB
  4.3.3 MCCB
4.4 Wires and Power Cable
4.5 Types of Wiring System
4.6 Determination of Size of Conductor
4.7 Earthing System and its importance
4.8 Electrical Safety Rules

Tutorial

The tutorial sessions will focus on chapter-specific exercises aimed at enhancing understanding and application in Electrical and Electronics Engineering (15 hours)

Assignment

1. Numerical and theory works

Laboratory

1. Verification of Ohms law and Kirchhoff's law
2. Measurement of AC quantities using oscilloscope and study phase relation of RL and RC load.
3. Measurement of line, phase and power in three-phase balanced load.
4. Load test on single phase transformer and T-S characteristics of induction Machine.
5. Connection of electrical installations of residential buildings.
6. To study Characteristics of PN and Zener Diodes and Perform Half wave

and Full Wave rectifiers.

Reference

1. Mehta, V. K., and Mehta Rohit. Principle of Electrical Engineering and Electronics. S. Chand Publishing, 2014.
2. Bhattacharya, S. K. Basic Electrical and Electronics Engineering I, Pearson Education India, 2010.
3. Bakshi, Uday A., and Mayuresh V. Bakshi. Electrical technology. Technical Publications, 2020.
4. Floyd, Thomas L. Digital fundamentals, 10/e. Pearson Education India, 2011.
5. Neidle, Michael. Electrical installation technology. Elsevier, 2016

ENGINEERING MECHANICS
CE 101

Lecture : 4 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
This course helps to analyze the effect of various types of Forces on the particle and rigid body at rest and motion. It also provides concept and knowledge of Engineering Application and helps to understand Structural Engineering in later courses by using basics of Mechanics in their branch of engineering.

1 Basic Concept of Mechanics and Static Equilibrium (5 hours)

1.1 Definitions, Type and Scope of Mechanics
1.2 Fundamental Concepts and Principles of Engineering Mechanics
1.3 Concept of Particle, Rigid and Deformed Bodies
1.4 Physical Meaning of Equilibrium and its Essence in Structural Application
1.5 Equation of Equilibrium in 2D and 3D Analysis of Particle and Rigid Body
1.6 Concept of Free Body Diagram with Examples

2 Forces Acting on Particle and Rigid Body (9 hours)

2.1 Different Types of Forces: Internal/External Force, Adhesive/ Cohesive Force, Point/ Line/ Surface Force and Contact/ Body Force
2.2 Resolution and Composition of Forces
2.3 Principle of Transmissibility and Equivalent Forces
2.4 Varignon's Theorem and it's Application
2.5 Moments of a Force About a Point and About an Axis
2.6 Definition, Types and Characteristics of Couple
2.7 Resolution of a Force into a Force and a Couple
2.8 Resultant of Force and Moment for a System: Coplanar, Concurrent and General Force System
2.9 Concept and Formation of Wrench (Force and Couple Lying on a Single Plane)

3 Friction (4 hours)

3.1 Definition, Types and Uses of Friction, Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction
3.2 Sliding and Overturning Condition of a Body
3.3 Concept and Working Principle of Jackscrew
3.4 Practical Examples of Dry Friction (Ladder and Wedge Friction)

4 Analysis of Simple Beams and Frames (10 hours)

4.1 Introduction to Structures
4.2 Various Types of Load on the Structure
4.3 Various Types of Supports; Reactions and Degree of Freedom
4.4 Internal and External Forces in the Structure
4.5 Relationship Between Load, Shear Force and Bending Moment
4.6 Statically and Geometrically Stable/ Unstable Beams and Frames
4.7 Statically Determinate and Indeterminate Beams and Frames, Degree of Static Indeterminacy
4.8 Axial Force, Shear Force and Bending Moment Diagrams for Determinate Beams and Frames

5 Analysis of Plane Trusses (5 hours)

5.1 Definition of Truss, Assumption of Ideal Truss, Types and Uses of Truss in Engineering
5.2 Statically and Geometrically Stable and Unstable Truss
5.3 Statically Determinate and Indeterminate Truss, Degree of Static Indeterminacy
5.4 Analysis of Truss by the Method of Joint and Section/ Moment

5 Centre of Gravity, Centroid, Moment of Inertia, and Mass Moment of Inertia (5 hours)

6.1 Concepts of Centre of Gravity and Centroid of Line, Area and Volume
6.2 Second Moment of Area/Moment of Inertia and Radius of Gyration
6.3 Perpendicular and Parallel Axis Theorem for Moment of Inertia
6.4 Concept of Mass Moment of Inertia

7 Kinematics of Particles (Rectilinear and Curvilinear Motion) (7 hours)

7.1 Position, Velocity and Acceleration of a Particle for Rectilinear Motion
7.2 Dependent and Relative Motion of Particles
7.3 Position, Velocity and Acceleration of a Particle for Curvilinear Motion
7.4 Projectile Motion
7.5 Tangential and Normal Components of Velocity and Acceleration
7.6 Radial and Transverse Components of Velocity and Acceleration

8 Kinetics of Particles: Force, Acceleration, Energy and Momentum (8 hours)

8.1 Newton's Second Law of Motion, Linear Momentum and Impulsive Motion
8.2 Equation of Motion and Dynamic Equilibrium
8.3 Angular Momentum and Rate of Change of Angular Momentum
8.4 Equation of Motion for Rectilinear and Curvilinear Motion (Rectangular Components, Tangential & Normal Components and Radial & Transverse Components) of Particle
8.5 Work and Energy Principle
8.6 Principle of Conservation of Energy, Concept of Conservative and Non-Conservative System

8.7 Definition and Types of Impact

9 Kinematics and Kinetics of Rigid Body in Plane Motion, Energy and Momentum Methods (7 hours)

9.1 Translation, Rotation and General Plane Motion
9.2 Absolute and Relative Velocity in Plane Motion
9.3 Instantaneous Centre of Rotation
9.4 Equation of Motion: D'Alembert's Principle
9.5 Angular Momentum of Rigid Body
9.6 Principle of Work and Energy for a Rigid Body
9.7 Kinetic Energy for a Rigid Body

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Basic Concept of Mechanics and Static Equilibrium (2 hours)
2. Forces Acting on Particle and Rigid Body (4 hours)
3. Friction (2 hours)
4. Analysis of Simple Beams and Frames (6 hours)
5. Analysis of Plane Trusses (3 hours)
6. Centre of Gravity, Centroid, Moment of Inertia and Mass Moment of Inertia (4 hours)
7. Kinematics of Particles (Rectilinear and Curvilinear Motion) (3 hours)
8. Kinetics of Particles: Force, Acceleration, Energy and Momentum (3 hours)
9. Kinematics and Kinetics of Rigid Body in Plane Motion, Energy and Momentum Methods (3 hours)

Reference

1. Beer F.P. and E.R. Johntson "Vector Mechanics for Engineers", Tata McGraw Hill Publishing Co.Ltd.
2. R.C. Hibbler, Ashok Gupta, "Engineering Mechanics –Statics and Dynamics", New Delhi, Pearson,
3. I.C. Jong and B.G. Rogers, "Engineering Mechanics- Statics and Dynamics",
4. R. Suwal, "A Text Book of Applied Mechanics" Second Edition, Mark Line Publication
5. H.R. Parajuli and S. Neupane "Applied Mechanics for Engineers" M.K. Publishers and Distributors
6. H.R. Parajuli and S. Neupane "Applied Mechanics II (Dynamics) for Engineers" M.K. Publishers and Distributors
7. M.R. Dhital, "A Course Manual on Applied Mechanics I (Statics)", TU, IOE, CIMDU,
8. M.R. Dhital, "A Course Manual on Applied Mechanics II (Dynamics)", TU, IOE, CIMDU,
9. Shame, I.H., "Engineering Mechanics- Statics and Dynamics", Prentice Hall of India, New Delhi,

10. D.K. Anand and P.F. Cunnif, “Engineering Mechanics- Statics and Dynamics”,
11. R.S. Khurmi, “A Text Book of Engineering Mechanics”,
12. Egor. P. Popov “Engineering Mechanics of Solids”, New Delhi, Prentice Hall of India.

ENGINEERING GEOLOGY I

CE 102

Lecture : 2 **Year : I**
Tutorial : 0 **Part : I**
Practical : 1

Course Objectives:
The course will provide the basic knowledge of engineering geology to the civil engineering students. Students will be able to understand the fundamental of engineering geology and various natural process and their influence on the surface as well as sub-surface features, identification of rocks and their significance, enhance the knowledge of mountain building process and importance in the field of civil engineering

1 Introduction to Engineering Geology (2 hours)

1.1 Introduction to Geology, its branches, and their interrelationships
1.2 Definition of engineering geology and its importance in civil engineering
1.3 Importance of engineering geology in the context of Nepal

2 Structure of the Earth (3 hours)

2.1 Origin, and internal structure of earth
2.2 Plate tectonics and mountain building process
2.3 Geological time scale and evolution of life

3 Mineralogy and Petrology (7 hours)

3.1 Formation of minerals, crystal morphology, physical and chemical properties of minerals
3.2 Rock forming minerals and their engineering significance
3.3 Formation of rocks and their classifications
3.4 Introduction, classification, structure, texture, uses, engineering significance and field identification criteria of igneous rock, sedimentary rock, and metamorphic rock

4 Structural Geology (8 hours)

4.1 Introduction of geological plane and its orientation (Dip, Strike, Plunge, and Trend)
4.2 Study of different geological structures: Primary sedimentary structures (bedding, lamination, cross-bedding, ripple marks etc.) and secondary structures (Lineation, foliation, folds, joints, faults, and thrusts)
4.3 Field identification criteria of the different geological structure with their importance in civil engineering

5 Physical Geology (6 hours)

5.1 Introduction, definition, different geological agents (river, groundwater, glacier, wind, and sea water)
5.2 Weathering and erosion, different geomorphological features produced by geological agents
5.3 Volcanism

6 Geology of the Himalaya (4 hours)

6.1 Evolution of the Himalayas
6.2 Tectonic sub-division of the Himalaya (Indo-Gangetic Plain, Siwalik, Lesser Himalayas, Higher Himalaya, Tibetan-Tethys Himalayan zone) and physiographic sub-division of the Himalaya
6.3 Major discontinuities systems and their engineering significance and engineering geological problems in the different tectonic sub-division of the Himalaya

Laboratory

1. Identification of common rock forming minerals (Quartz, Feldspar, Muscovite, Biotite, Chlorite, Calcite, Dolomite, Tourmaline, Pyrite, Talc, Fluorite, Apatite, Corundum, Diamond, Kyanite, Sillimanite, Garnet and clay minerals)
2. Identification of rocks: Shale, Limestone, Sandstone, Siltstone, Conglomerate, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble, Granite, Rhyolite, Gabbro, Basalt, Amphibolite, Syenite)
3. Study of different geological structures in the block diagram
4. Study of maps: Topographic and geological maps, construction of geological cross-section and their interpretation

Field works (2 days)

A two-day fieldwork to provide practical on-site knowledge on preparation and interpretation of engineering geological mapping (measurement of geological plane using geological compass, identification of minerals and rocks, geomorphology, and geological structures etc). Students submit report after the fieldwork **(Attendance in Fieldwork is Compulsory)**.

Reference

1. A. Holmes (1978). Principles of Physical Geology", ELBS English Language Society
2. Bell, F. G. (2006). Engineering Geology. 2nd Edition, Elsevier.
3. Krynine, D., & Judd, W. R. (2005). Principles of Engineering Geology and Geotechnics. CBS Publishers.
4. Deoja, B., Dhital, M., Wagner, A., & K.B, T. (1991). Mountain Risk Engineering Handbooks I and II. ICIMOD.
5. Dhital, M.R. (2015), Geology of the Nepal Himalaya, Springer International Published, Switzerland

6. Price, D. (2009). Engineering Geology- Principles and Practice. (M. H. de Freitas, Ed.) Springer.Hoek, E., and Brown, E.T. (2019). The Hoek-Brown failure criterion and GSI-2018 edition, Journal of Rock Mechanics and Geotechnical Engineering, 11, 445-463.
7. Vallejo, L.G.de., Ferrer, M. (2011). Geological Engineering, Routledge, Taylor and Francis Group,

CIVIL ENGINEERING MATERIALS

CE 103

Lecture : 2 **Year : I**
Tutorial : 0 **Part : I**
Practical : 1

Course Objectives:
To provide students an introductory knowledge about the wide range of materials used in the construction of engineering projects. This course emphasizes on the property, defects, productions, preservation, alternatives and utilities of various civil engineering materials which would help in selection of the suitable materials for construction projects. This helps to build a base for the selection, adequate consideration and precautions in aspect of materials during design and construction.

1 Basics of Civil Engineering Materials (2 hours)

1.1 Materials used in engineering constructions: buildings; road and bridges; irrigation and hydropower; water, gas and petroleum supply
1.2 Classification of materials on various basis: existence in nature, functions or usage; metallurgy; composition of materials
1.3 Properties: physical; chemical; mechanical; thermal; optical; electrical; magnetic
1.4 Failure of materials: ductile and brittle failure
1.5 Factors affecting selection of materials: properties and performance; attributes and suitability; durability, safety and requirements; availability, reliability and disposability; and economy and environment
1.6 Material and environment interactions: corrosion; weathering; erosion; thermal strain; exposure to moisture, sunlight, and chemicals

2 Stones (3 hours)

2.1 Classification of rocks and aggregates: geological, physical and chemical classifications of rocks; introduction to coarse and fine aggregates
2.2 Properties of stones: physical, chemical and mechanical properties
2.3 Characteristics of good stones: appearance; structure; strength; porosity and absorption; weathering; fire resistance; hardness and toughness; specific gravity; thermal properties
2.4 Selection and use of stones: selection criteria; various uses of stones in engineering constructions
2.5 Deterioration and preservation of stones: deterioration and its retardation; preservation and preservatives used in stones
2.6 Production, storage and handling of stones: natural bed of stones; selection of quarry site; methods of quarrying; dressing of stones

3 Clay and Clay Products (3 hours)

3.1 Clay: use of clay in constructions; classification/types of clays; properties of clays

3.2 Brick earth: constituents; properties, testing (consistency test; molding property test; deformation and shrinkage test on burning, strength and quality of brick test)

3.3 Bricks: use of bricks; manufacturing of local bricks; classification and properties (including) mechanical properties) of bricks (unburnt and burnt bricks); characteristics of good bricks; standard tests for bricks (shape and size test; color test; structure test; soundness test; hardness test; water adsorption test; efflorescence test; compressive strength test)

3.4 Tiles: use of tiles; manufacturing process of tiles; types and properties of tiles (roof tiles, wall tiles, floor tiles, drain tiles); characteristics of good tiles

3.5 Terracotta, earthenware and glazing: properties; use; composition; production

3.6 Storage and handling of clay and clay products

4 Lime (2 hours)

4.1 Sources and constituent of limestones: limestones and stone lime; kankar lime; shell lime; magnesian lime; impurities in limestones

4.2 Classification/types of limes: quick lime; flat lime, hydraulic lime, poor lime; hydrated lime; milk lime; lump lime

4.3 Characteristics of lime, hydration of lime, slaking nature of lime, solidification of lime

4.4 Manufacture/production of lime: Flow diagram of lime production from limestone and kankar

4.5 Storage, handling and use of different types of lime

4.6 Types of pozzolanic materials and use with lime: volcanic ash; calcinated clay products; clay/kaolin pozzolana; mineral slag; ashes of organic origin

5 Cement (4 hours)

5.1 Fundamentals of cement: ingredients of cement; type and properties of cement; storage, handling and use of cement; characteristics of good cement

5.2 Classification of cements: natural and artificial; different types of cements, their composition, properties and applications (ordinary Portland cement (OPC), rapid hardening cement, slow setting cement, Portland pozzolana cement (PPC), white cement, colored cement)

5.3 Manufacture of ordinary cement: dry manufacturing process; wet manufacturing process

5.4 Tests of cement: field test; laboratory tests (fineness test, consistency test, initial and final setting time test, soundness test, compressive and tensile strength test)

5.5 Cement clinkers: compounds of cement clinkers and their functions in cement

5.6 Hydration of cement and admixtures: function and examples of admixture like water proofers, accelerators, retarders, plasticizers, air entraining agents.

6 Mortar (2 hours)

6.1 Function and use of mortar

6.2 Properties of mortar: workability, inertness, setting and hardening, adhesion

6.3 Types of mortars: classification (on the basis of binding materials, bulk density, nature of applications; special mortars); properties and use of different types of mortar

6.4 Preparation, storage and handling of mortar: hand mixing, machine mixing; storage and handling of mortar

6.5 Selection of mortar for different construction works: selection criteria; characteristics of a good mortar

6.6 Testing of mortars: crushing strength test, tensile strength test, adhesiveness test on building unit

7 Timber (3 hours)

7.1 Tree and timber: growth and structure of tree; properties (including mechanical) and use of timber; defects in timber (during growth of trees, after felling of trees); characteristics of good timber

7.2 Classification of tree and properties of wood: hard wood, soft wood

7.3 Seasoning of timber: definition and importance of seasoning; types of seasoning (natural and artificial seasoning)

7.4 Deterioration and preservation of timber: deterioration (physical, chemical, biological); types of preservatives; methods of preservation

7.5 Commercial product of timber: veneers and ply wood; boards (laminated boards, fiber boards, block boards, and batten boards); impreg and compreg timbers

7.6 Bamboo: properties (including mechanical) of bamboo; structural use of bamboo

8 Metals and Alloys (4 hours)

8.1 Metals: classification (ferrous and nonferrous metals); properties (physical, chemical, mechanical, electrical, thermal, magnetic)

8.2 Sources, composition, properties and uses of ferrous metals: pig iron, cast iron, wrought iron, steel, alloys of steel

8.3 Sources, properties and uses of nonferrous metals: aluminum, copper, lead, tin, zinc, magnesium, nickel

8.4 Heat treatment process and its importance in metals: annealing, normalizing, quenching or hardening, tempering, surface hardening (case hardening, nitriding, cyaniding, flame/ induction/laser hardening), defects in heat treatments

8.5 Commercial forms of metals and their uses: sheets, channel sections (I, C, angle, tubular), bars

8.6 Corrosion and its prevention in steel: theory of corrosion and its prevention with enameling; applying metal coatings – galvanizing, tin plating, electroplating; applying coatings – painting and tarring.

9 Paints and Varnishes (3 hours)

9.1 Paints: function and ingredients of paints; characteristics of good paint

9.2 Type, composition, properties and uses of paints: Oil paints; Aluminum paints; Asbestos paints; Bituminous paints; Cellulose paints; Cement paints; Colloidal paints; Emulsion paints; Enamel paints; Graphite paints; Silicate paints; Anticorrosion paints; Plastic paints; Synthetic rubber paints; Distempers

9.3 Varnishes: function and ingredients of varnishes; characteristics of good varnishes

9.4 Type, composition, properties and uses of varnishes: Oil varnish; Turpentine varnish; Spirit varnish; Water varnish; Asphalt varnish; Spar varnish; Flat varnish

9.5 Process of application of different paints and varnishes: application in new surfaces; application in old surfaces

9.6 Defects in paints and varnishes: effects of background (dampness, cleanness movement reactions); effects of weather (blistering, peeling, checking, cracking, flaking, chalking, alligatoring, wrinkling, running and sagging, mildew, bloom, flashing, grining)

10 Miscellaneous Materials (4 hours)

10.1 Asphalt: origin, composition, properties, types and uses

10.2 Bitumen: origin, composition, properties, types and uses

10.3 Tar: origin, composition, properties, types and uses

10.4 Other materials: composition, properties, types and uses of – glass, plastic materials, rubber materials, insulating materials, gypsum products, adhesive and sealant materials, anti-termite treatment, water proofers, geosynthetics , carbon fiber)

10.5 Composite materials: composition, properties, types and uses of – cement steel reinforced concrete, fiber reinforced plastics, glass fiber reinforced cement concrete or plastics, metal matrix composite

10.6 Emerging materials: Calcium silicate bricks; Concrete blocks; Aerated Autoclave Concrete blocks (AAC blocks); Interlocking Compressed Stabilized Earth Blocks (Interlocking CSEB), panels and boards

Assignments

1. Various ways to join timbers and metals
2. Commercially available other new materials used in constructions

Laboratory

1. Water absorption test and bulk density, specific gravity test on brick sample
2. Compressive strength test of brick and stones
3. Consistency test of cement

4. Fineness and soundness test of cement
5. Setting time test of cement
6. Compressive strength of cement
7. Toughness test on steel and timber

Reference

1. Duggal, S. K. (2008). Building Materials. New Delhi: New Age International (P) Ltd., Publishers.
2. Mamlouk, M. S., & Zaniewski, J. P. (2018). Materials for Civil and Construction Engineers. Harlow: Pearson Education Limited.
3. Rajput, R. K. (2004). Engineering Materials. S. Chand & Company Ltd
4. Singh, P. (2010). Civil Engineering Materials. New Delhi: S K Kataria & Sons
5. Thornton, P. A., & Prentice, V. J. (1985). Fundadmental of Engineering Materials . Hall Publishing Company.

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : I

Part : II

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 451	Engineering Mathematics - II	3	2		5	20	3	80				100	
2	ME 451	Engineering Drawing II	1		3	4				60	3	40	100	
3	EX 451	Basic Electronics Engineering	3	1	1.5	5.5	20	3	80	25			125	
4	SH 452	Engineering Physics	4	1	2	7	20	3	80	20	3	30	150	
5	CE 451	Applied Mechanics	3	2		5	20	3	80				100	
6	EE 451	Basic Electrical Engineering	3	1	1.5	5.5	20	3	80	25			125	
		Total	**17**	**7**	**8**	**32**	**100**	**15**	**400**	**130**	**6**	**70**	**700**	

ENGINEERING MATHEMATICS II

SH 451

Lecture : 3 **Year : I**
Tutorial : 2 **Part : II**
Practical : 0

Course Objective:

To develop the skill of solving differential equations and to provide knowledge of vector algebra and calculus. To make students familiar with calculus of several variables and infinite series.

1. Calculus of Two or More Variables **(6 hours)**

1.1 Introduction: limit and continuity
1.2 Partial derivatives
  1.2.1 Homogeneous function, Euler's theorem for the function of two and three variables
  1.2.2 Total derivatives
1.3 Extreme of functions of two and three variables; Lagrange's Multiplier

2. Multiple Integrals **(6 hours)**

2.1 Introduction
2.2 Double integrals in Cartesian and polar form; change of order of integration
2.3 Triple integrals in Cartesian, cylindrical and spherical coordinates;
2.4 Area and volume by double and triple integrals

3. Three Dimensional Solid Geometry **(11 hours)**

3.1 The straight line; Symmetric and general form
3.2 Coplanar lines
3.3 Shortest distance
3.4 Sphere
3.5 Plane Section of a sphere by planes
3.6 Tangent Planes and lines to the spheres
3.7 Right circular cone
3.8 Right circular cylinder

4. Solution of Differential Equations in Series and Special Functions (9 hours)

4.1 Solution of differential equation by power series method
4.2 Legendre's equation
4.3 Legendre polynomial function; Properties and applications.
4.4 Bessel's equation
4.5 Bessel's function of first and second kind. Properties and applications

5. Vector Algebra and Calculus **(8 hours)**

5.1 Introduction
5.2 Two and three dimensional vectors

5.3 Scalar products and vector products
5.4 Reciprocal System of vectors
5.5 Application of vectors: Lines and planes
5.6 Scalar and vector fields
5.7 Derivatives – Velocity and acceleration
5.8 Directional derivatives

6. Infinite Series **(5 hours)**

6.1 Introduction
6.2 Series with positives terms
6.3 convergence and divergence
6.4 Alternating series. Absolute convergence
6.5 Radius and interval of convergence

References:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", John Wiley and Sons Inc.
2. Thomas, Finney, "Calculus and Analytical Geometry", Addison- Wesley
3. M. B. Singh, B. C. Bajrachrya, "Differential Calculus", Sukunda Pustak Bhandar,Nepal
4. M. B. Singh, B. C. Bajrachrya, "A Text Book of Vectors", Sukunda Pustak Bhandar,Nepal
5. M. B. Singh, S. P. Shrestha, "Applied Engineering Mathematics", RTU, Department of Engineering Science and Humanities.
6. G.D. Pant, G. S. Shrestha, "Integral Calculus and Differential Equations", Sunila Prakashan,Nepal
7. Y. R. Sthapit, B. C. Bajrachrya, "A Text Book of Three Dimensional Geometry", Sukunda Pustak Bhandar,Nepal
8. Santosh Man Maskey, "Calculus", Ratna Pustak Bhandar, Nepal

ENGINEERING DRAWING II

ME 451

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

Course Objective:

To make familiar with the conventional practices of sectional views. To develop basic concept and skill of pictorial drawing and working drawings. Also to make familiar with standard symbols of different engineering fields.

1. Conventional Practices for Orthographic and Sectional Views (12 hours)

1.1 Conventional Practices in Orthographic views: Half Views and Partial Views, Treatment of Unimportant Intersections, Aligned Views, Treatment for Radially Arranged Features, Representation of Fillets and Rounds

1.2 Conventional Practices in Sectional views: Conventions for Ribs, Webs and Spokes in Sectional View, Broken Section, Removed Section, Revolved Section, Offset Section, Phantom Section and Auxiliary Sectional Views

1.3 Simplified Representations of Standard Machine Elements

2. Pictorial Drawings (20 hours)

2.1 Classifications: Advantages and Disadvantages

2.2 Axonometric Projection: Isometric Projection and Isometric Drawing
- 2.2.1 Procedure for making an isometric drawing
- 2.2.2 Isometric and Non-isometric Lines; Isometric and Non-isometric Surfaces
- 2.2.3 Angles in Isometric Drawing
- 2.2.4 Circles and Circular Arcs in Isometric Drawing
- 2.2.5 Irregular Curves in Isometric Drawing
- 2.2.6 Isometric sectional Views

2.3 Oblique Projection and Oblique Drawing
- 2.3.1 Procedure for making an Oblique drawing
- 2.3.2 Rules for Placing Objects in Oblique drawing
- 2.3.3 Angles, Circles and Circular Arcs in Oblique drawing

2.4 Perspective Projection
- 2.4.1 Terms used in Perspective Projection
- 2.4.2 Parallel and Angular Perspective
- 2.4.3 Selection of Station Point

3. Familiarization with Different Components and Conventions (8 hours)

3.1 Limit Dimensioning and Machining Symbols
- 3.1.1 Limit, Fit and Tolerances
- 3.1.2 Machining Symbols and Surface Finish

3.2 Threads, Bolts and Nuts
- 3.2.1 Thread Terms and Nomenclature, Forms of Screw Threads
- 3.2.2 Detailed and Simplified Representation of Internal and External Threads
- 3.2.3 Thread Dimensioning
- 3.2.4 Standard Bolts and Nuts: Hexagonal Head and Square Head
- 3.2.5 Conventional Symbols for Bolts and Nuts

3.3 Welding and Riveting
- 3.3.1 Types of Welded Joints and Types of Welds, Welding Symbols
- 3.3.2 Forms and Proportions for Rivet Heads, Rivet Symbols, Types of Riveted Joints: Lap Joint, Butt Joint

3.4 Familiarization with Graphical Symbols and Conventions in Different Engineering Fields
- 3.4.1 Standard Symbols for Civil, Structural and Agricultural Components
- 3.4.2 Standard Symbols for Electrical, Mechanical and Industrial Components
- 3.4.3 Standard Symbols for Electronics, Communication and Computer Components
- 3.4.4 Topographical Symbols

3.5 Standard Piping Symbols and Piping Drawing

4. Detail and Assembly Drawings (20 hours)

4.1 Introduction to Working Drawing

4.2 Components of Working Drawing: Drawing Layout, Bill of Materials, Drawing Numbers

4.3 Detail Drawing

4.4 Assembly Drawing

4.5 Practices of Detail and Assembly Drawing: V-block Clamp, Centering Cone, Couplings, Bearings, Antivibration Mounts, Stuffing Boxes, Screw Jacks, etc

Practical:

1. Conventional Practices for Orthographic and Sectional Views (Full and Half Section)
2. Conventional Practices for Orthographic and Sectional Views (Other Type Sections)
3. Isometric Drawing
4. Isometric Drawing (Consisting of Curved Surfaces and Sections)
5. Oblique Drawing
6. Perspective Projection
7. Familiarization with Graphical Symbols (Limit, Fit, Tolerances and Surface Roughness Symbols)
8. Familiarization with Graphical Symbols (Symbols for Different Engineering Fields)

9. Detail Drawing
10. Assembly Drawing I
11. Assembly Drawing II
12. Building Drawing

References:

1. W. J. Luzadder, " Fundamentals of Engineering Drawing", Prentice Hall.
2. T. E. French, C. J. Vierck, and R. J. Foster, "Engineering Drawing and Graphic Technology", Mc Graw Hill Publshing Co.
3. F. E. Giescke, A . Mitchell, H. C. Spencer and J. T. Dygdone, "Technical Drawing", Macmillan Publshing Co.
4. N. D. Bhatt, "Machine Drawing", Charotar Publshing House, India.
5. P. S. Gill, "Machine Drawing", S. K. Kataria and Sons, India.
6. R. K. Dhawan "Machine Drawing", S. Chand and Company Limited, India.

BASIC ELECTRONICS ENGINEERING
EX 451

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

Course Objectives:

To understand the electronics elements and their functionality, basic understanding of analog and digital systems and their applications

1. Basic Circuits Concepts **(4 hours)**

1.1 Passive components: Resistance, Inductance, Capacitance; series, parallel combinations; Kirchhoff's law: voltage, current; linearity
1.2 Signal sources: voltage and current sources; nonideal sources; representation under assumption of linearity; controlled sources: VCVS, CCVS, VCCS, CCCS; concept of gain, transconductance, transimpedance.
1.3 . Superposition theorem; Thevenin's theorem; Norton's theorem
1.4 Introduction to filter

2. Diodes **(6 hours)**

2.1 Semiconductor diode characteristics
2.2 Modeling the semiconductor diode
2.3 Diode circuits: clipper; clamper circuits
2.4 Zener diode, LED, Photodiode, varacters diode, Tunnel diodes
2.5 DC power supply: rectifier-half wave, full wave (center tapped, bridge), Zener regulated power supply

3. Transistor **(8 hours)**

3.1 BJT configuration and biasing, small and large signal model
3.2 T and μ model
3.3 Concept of differential amplifier using BJT
3.4 BJT switch and logic circuits
3.5 Construction and working principle of MOSFET and CMOS
3.6 MOSFET as logic circuits

4. The Operational Amplifier and Oscillator **(7 hours)**

4.1 Basic model; virtual ground concept; inverting amplifier; non-inverting amplifier; integrator; differentiator, summing amplifier and their applications
4.2 Basic feedback theory; positive and negative feedback; concept of stability; oscillator
4.3 Waveform generator using op-amp for Square wave, Triangular wave Wien bridge oscillator for sinusoidal waveform

5. Communication System **(4 hours)**

5.1 Introduction
5.2 Wired and wireless communication system

5.3 EMW and propagation, antenna, broadcasting and communication
5.4 Internet / intranet
5.5 Optical fiber

6. Digital Electronics **(11 hours)**

6.1 Number systems, Binary arithmetic
6.2 Logic gates: OR, NOT, AND NOR, NAND, XOR, XNOR gate; Truth tables
6.3 Multiplexers; Demux, Encoder, Decoder
6.4 Logic function representation
6.5 Combinational circuits: SOP, POS form; K-map;
6.6 Latch, flip-flop: S-R flip-flop; JK master slave flip-flop; D-flip flop
6.7 Sequential circuits: Generic block diagram; sift registers; counters

7. Application of Electronic System **(5 hours)**

7.1 Instrumentation system: Transducer, strain gauge, DMM, Oscilloscope
7.2 Regulated power supply
7.3 Remote control, character display, clock, counter, measurements, date logging, audio video system

Practical:

1. Familiarization with passive components, function generator and oscilloscope
2. Diode characteristics, rectifiers, Zener diodes
3. Bipolar junction transistor characteristics and single stage amplifier
4. Voltage amplifiers using op-amp, Comparators, Schmitt
5. Wave generators using op-amp
6. Combinational and sequential circuits

References

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" PHI
2. Thomas L. Floyd, "Electronic Devices" Pearson Education, Inc., 2007
3. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford University Press, 2006

ENGINEERING PHYSICS
SH 452

Lecture : 4 **Year : I**
Tutorial : 1 **Part : II**
Practical : 2

Course objectives:

To provide the concept and knowledge of physics with the emphasis of present day application.

1. Oscillation: **(7 hours)**

1.1 Mechanical Oscillation: Introduction
1.2 Free oscillation
1.3 Damped oscillation
1.4 forced mechanical oscillation
1.5 EM Oscillation: Free, damped and Forced electromagnetic oscillation

2. Wave motion **(2 hours)**

2.1 Waves and particles,
2.2 Progressive wave,
2.3 Energy, power and intensity of progressive wave

3. Acoustics **(3 hours)**

3.1 Reverberation,
3.2 Sabine' Law
3.3 Ultrasound and its applications

4. Physical Optics **(12 hours)**

4.1 Interference,
  4.1.1 Intensity in double slit interference,
  4.1.2 Interference in thin films,
  4.1.3 Newton's rings,
  4.1.4 Hadinger fringes
4.2 Diffraction,
  4.2.1 Fresnel and Fraunhoffer's diffraction,
  4.2.2 intensity due to a single slit;
  4.2.3 diffraction grating,
  4.2.4 x-ray diffraction, x-ray for material test
4.3 Polarization,
  4.3.1 double refraction,
  4.3.2 Nichol prism, wave plates,
  4.3.3 optical activity, specific rotation

5. Geometrical Optics **(3 hours)**

5.1 Lenses, combination of lenses,
5.2 cardinal points,

5.3 chromatic aberration

6. Laser and Fiber Optics **(4 hours)**

6.1 Laser production,
- 6.1.1 He-Ne laser,
- 6.1.2 Uses of laser

6.2 Fiber Optics,
- 6.2.1 self focusing,
- 6.2.2 applications of optical fiber

7. Electrostatics **(8 hours)**

7.1 Electric charge and force,
7.2 electric field and potential,
7.3 electrostatic potential energy,
7.4 capacitors, capacitor with dielectric,
7.5 charging and discharging of a capacitor

8. Electromagnetism **(11 hours)**

8.1 Direct current: Electric current,
- 8.1.1 Ohm's law, resistance and resistivity,
- 8.1.2 semiconductor and superconductor

8.2 Magnetic fields:
- 8.2.1 Magnetic force and Torque,
- 8.2.2 Hall effect,
- 8.2.3 cyclotron, synchrotron,
- 8.2.4 Biot-Savart law,
- 8.2.5 Ampere's circuit law; magnetic fields straight conductors,
- 8.2.6 Faraday's laws, Induction and energy transformation, induced field,
- 8.2.7 LR circuit, induced magnetic field,
- 8.2.8 displacement current

9. Electromagnetic waves **(5 hours)**

9.1 Maxwell's equations,
9.2 wave equations, speed,
9.3 E and B fields,
9.4 continuity equation,
9.5 energy transfer

10. Photon and matter waves **(5 hours)**

10.1 Quantization of energy;
10.2 electrons and matter waves;
10.3 Schrodinger wave equation;
10.4 probability distribution;
10.5 one dimensional potential well;
10.6 uncertainty principle;
10.7 barrier tunneling

Practical:

1. To determine the acceleration due to gravity and radius of gyration of the bar about an axis passing through its center of gravity.
2. To determine the value of modulus of elasticity of the materials given and moment of inertia of a circular disc using torsion pendulum.
3. To determine the angle of prism and dispersive power of materials of the prism using spectrometer.
4. To determine the wavelength of sodium light by Newton's rings.
5. To determine the wavelength of He-Ne laser light and use it to measure the thickness of a thin wire by diffraction of light.
6. To study the variation of angle of rotation of plane of polarization using concentration of the cane sugar solution
7. To determine the specific rotation of the cane sugar solution using polarimeter.
8. To determine the low resistance of a given wire by Carey Foster bridge and to determine the resistance per unit length of the wire of the bridge.
9. To determine the capacitance of a given capacitor by charging and discharging through resistor.
10. To plot a graph between current and frequency in an LRC series circuit and find the resonant frequency and quality factor.
11. To determine dielectric constant of a given substance and study its variation with frequency by resonance method.
12. To determine the susceptibility of a solution of given materials by Quinkes method.
13. To study the electric field mapping.

References:

1. Halliday, Resnick, Walker, "Fundamentals of Physics", John Wiley & Sons. Inc.
2. Sapkota, Pokharel, Bhattarai, "Fundamentals of Engineering Physics", Benchmark Publication.
3. Brij Lal and Subrahmanyam, "A text book of Optics", S. Chand Publisher.
4. A. S. Basudeva, "Modern Engineering Physics", S. Chand Publisher.
5. R. K. Gaur and S. L. Gupta, "Engineering Physics", Dhanpat Publisher.
6. Brij Lal and Subrahmanyam, "Waves and Oscillation", S. Chand Publisher.

APPLIED MECHANICS
CE 451

Lecture : 3 **Year : I**
Tutorial : 2 **Part : II**
Practical : 0

Course Objective:

To provide concept and knowledge of engineering mechanics and help understand structural engineering stress analysis principles in later courses or to use basics of mechanics in their branch of engineering. Emphasis has been given to Statics.

1. Introduction **(2 hours)**

1.1 Definitions and scope of Applied Mechanics
1.2 Concept of Rigid and Deformed Bodies
1.3 Fundamental concepts and principles of mechanics: Newtonian Mechanics

2. Basic Concept in Statics and Static Equilibrium **(4 hours)**

2.1 Concept of Particles and Free Body Diagram
2.2 Physical meaning of Equilibrium and its essence in structural application
2.3 Equation of Equilibrium in Two Dimension

3. Forces Acting on Particle and Rigid Body **(6 hours)**

3.1 Different types of Forces: Point, Surface Traction and Body Forces -Translational Force and Rotational Force: Relevant Examples
3.2 Resolution and Composition of Forces: Relevant Examples
3.3 Principle of Transmissibility and Equivalent Forces: Relevant Examples
3.4 Moments and couples: Relevant Examples
3.5 Resolution of a Force into Forces and a Couple: Relevant Examples
3.6 Resultant of Force and Moment for a System of Force: Examples

4. Center of Gravity, Centroid and Moment of Inertia **(6 hours)**

4.1 Concepts and Calculation of Centre of Gravity and Centroid: Examples
4.2 Calculation of Second Moment of Area / Moment of Inertia and Radius of Gyration: And Relevant usages
4.3 Use of Parallel axis Theorem: Relevant Examples

5. Friction **(2 hours)**

5.1 Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction: Engineering Examples of usage of friction
5.2 Calculations involving friction in structures: Example as High Tension Friction Grip bolts and its free body diagram

6. Analysis of Beams and Frames **(9 hours)**

6.1 Introduction to Structures: Discrete and Continuum

6.2 Concept of Load Estimating and Support Idealizations: Examples and Standard symbols
6.3 Use of beams/frames in engineering: Concept of rigid joints/distribute loads in beams/frames.
6.4 Concept of Statically/Kinematically Determinate and Indeterminate Beams and Frames: Relevant Examples
6.5 Calculation of Axial Force, Shear Force and Bending Moment for Determinate Beams and Frames
6.6 Axial Force, Shear Force and Bending Moment Diagrams and Examples for drawing it.

7. Analysis of Plane Trusses (4 hours)

7.1 Use of trusses in engineering: Concept of pin joints/joint loads in trusses.
7.2 Calculation of Member Forces of Truss by method of joints: Simple Examples
7.3 Calculation of Member Forces of Truss by method of sections: Simple Examples

8. Kinematics of Particles and Rigid Body (7 hours)

8.1 Rectilinear Kinematics: Continuous Motion
8.2 Position, Velocity and Acceleration of a Particle and Rigid Body
8.3 Determination of Motion of Particle and Rigid Body
8.4 Uniform Rectilinear Motion of Particles
8.5 Uniformly Accelerated Rectilinear Motion of Particles
8.6 Curvilinear Motion: Rectangular Components with Examples of Particles

9. Kinetics of Particles and Rigid Body: Force and Acceleration (5 hours)

9.1 Newton's Second Law of Motion and momentum
9.2 Equation of Motion and Dynamic Equilibrium: Relevant Examples
9.3 Angular Momentum and Rate of Change
9.4 Equation of Motion-Rectilinear and Curvilinear
9.5 Rectangular: Tangential and Normal Components and Polar Coordinates: Radial and Transverse Components

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials can be as following for each specified chapters.

1. Introduction (1 hour)
   A. Theory; definition and concept type questions.
2. Basic Concept in Statics and Static Equilibrium (2 hours)
   A. Theory; definition and concept type questions.
3. Concept of Force acting on structures (3 hours)
   A. Practical examples; numerical examples and derivation types of questions.
   B. There can be tutorials for each sub-section.

4. Center of Gravity, Centroid and Moment of Inertia (4 hours)
   A. Concept type; numerical examples and practical examples type questions.
5. Friction (2 hours)
   A. Definition type; Practical example type and numerical type questions.
6. Analysis of Beam and Frame (5 hours)
   A. Concept type; definition type; numerical examples type with diagrams questions.
   B. There can be tutorials for each sub-section.
7. Analysis of Plane Trusses (5 hours)
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
8. Kinematics of Particles and Rigid Body (4 hours)
   A. Definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.
9. Kinetics of Particles and Rigid Body: Force and Acceleration (4 hours)
   A. Concept type; definition type; numerical examples type questions.
   B. There can be tutorials for each sub-section.

References:

1. F.P. Beer and E.R.Johnston, Jr. ,"Mechanics of Engineers- Statics and Dynamics", Mc Graw-Hill.
2. R.C. Hibbeler, Ashok Gupta, "Engineering Mechanics-Statics and Dynamics", New Delhi, Pearson.
3. I.C. Jong and B.G. Rogers, "Engineering Mechanics- Statics and Dynamics",
4. D.K. Anand and P.F. Cunnif, "Engineering Mechanics- Statics and Dynamics",
5. R.S. Khurmi, "A Text Book of Engineering Mechanics",
6. R.S.Khurmi, "Applied Mechanics and Strength of Materials",
7. I.B.Prasad, "A Text Book of Applied Mechanics",
8. Shame, I.H., "Engineering Mechanics-Statics and Dynamics", Prentice Hall of India, New Delhi.

BASIC ELECTRICAL ENGINEERING

EE 451

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

Course Objectives:

To provide the fundamental concept of DC, AC & 3-phase electrical circuits

1. General Electric System **(6 hours)**

- 1.1 Constituent parts of an electrical system (source, load, communication & control)
- 1.2 Current flow in a circuit
- 1.3 Electromotive force and potential difference
- 1.4 Electrical units
- 1.5 Ohm's law
- 1.6 Resistors, resistivity
- 1.7 Temperature rise & temperature coefficient of resistance
- 1.8 Voltage & current sources

2. DC circuits **(4 hours)**

- 2.1 Series circuits
- 2.2 Parallel networks
- 2.3 Krichhhof's laws
- 2.4 Power and energy

3. Network Theorems **(12 hours)**

- 3.1 Application of Krichhof's laws in network solution
  - 3.1.1 Nodal Analysis
  - 3.1.2 Mesh analysis
- 3.2 Star-delta & delta-star transformation
- 3.3 Superposition theorem
- 3.4 Thevninn's theorem
- 3.5 Nortan's theorem
- 3.6 Maximum power transfer theorem
- 3.7 Reciprocity theorem

4. Inductance & Capacitance in electric circuits **(4 hours)**

- 4.1 General concept of capacitance
  - 4.1.1 Charge & voltage
  - 4.1.2 Capacitors in series and parallel
- 4.2 General concept of inductance
  - 4.2.1 Inductive & non-inductive circuits
  - 4.2.2 Inductance in series & parallel

5. Alternating Quantities **(3 hours)**

5.1 AC systems
5.2 Wave form, terms & definitions
5.3 Average and rms values of current & voltage
5.4 Phasor representation

6. Single-phase AC Circuits **(6 hours)**

6.1 AC in resistive circuits
6.2 Current & voltage in an inductive circuits
6.3 Current and voltage in an capacitive circuits
6.4 Concept of complex impedance and admittance
6.5 AC series and parallel circuit
6.6 RL, RC and RLC circuit analysis & phasor representation

7. Power in AC Circuits **(4 hours)**

7.1 Power in resistive circuits
7.2 Power in inductive and capacitive circuits
7.3 Power in circuit with resistance and reactance
7.4 Active and reactive power
7.5 Power factor, its practical importance
7.6 Improvement of power factor
7.7 Measurement of power in a single-phase AC circuits

8. Three-Phase Circuit Analysis **(6 hours)**

8.1 Basic concept & advantage of Three-phase circuit
8.2 Phasor representation of star & delta connection
8.3 Phase and line quantities
8.4 Voltage & current computation in 3-phase **balance & unbalance** circuits
8.5 Real and reactive power computation
8.6 Measurements of power & power factor in 3-phase system

Practical:

1. Measurement of Voltage, current& power in DC circuit
   Verification of Ohm's Law
   Temperature effects in Resistance
2. Krichoff's Voltage & current Law
   Evaluate power from V & I
   Note loading effects of meter
3. Measurement amplitude, frequency and time with oscilloscope
   Calculate & verify average and rms value
   Examine phase relation in RL & RC circuit
4. Measurements of alternating quantities
   R, RL,RC circuits with AC excitation
   AC power, power factor, VARs, phasor diagrams
5. Three-phase AC circuits
   Measure currents and voltages in three-phase balanced AC circuits

Prove Y-Δ transformation
Exercise on phasor diagrams for three-phase circuits

6. Measurement of Voltage, current & power in a three-phase circuit
   Two-wattmeter method of power measurement in R, RL and RC three phase circuits
   Watts ratio curve

References:

1. J. R. Cogdell, " Foundations of Electrical Engineering", Prentice Hall, Englewood Chiffs, New Jersy, 1990.
2. I. M. Smith," Haughes Electrical Technology", Addison-Wesley, ISR Rprint,2000

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : II

Part : I

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 501	Engineering Mathematics III	3	2		5	20	3	80				100	
2	CE 501	Applied Mechanics (Dynamics)	2	1		3	10	1.5	40				50	
3	CE 502	Strength of Materials	3	1	1	5	20	3	80	25			125	
4	CE 503	Engineering Geology I	2		1	3	10	1.5	40	25			75	
5	CE 505	Fluid Mechanics	3	2	1	6	20	3	80	25			125	
6	CE 504	Surveying I	3		3	6	20	3	80	25	3	25	150	
7	CE 506	Civil Engineering Materials	2		1	3	10	3	40	25			75	
		Total	**18**	**6**	**7**	**31**	**110**	**18**	**440**	**125**	**3**	**25**	**700**	

ENGINEERING MATHEMATICS III

SH 501

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 0

Course Objective:

To round out the students' preparation for more sophisticated applications with an introduction to linear algebra, Fourier series, Laplace Transforms, integral transformation theorems and linear programming.

1. Determinants and Matrices **(11 hours)**

1.1 Determinant and its properties
1.2 Solution of system of linear equations
1.3 Algebra of matrices
1.4 Complex matrices
1.5 Rank of matrices
1.6 System of linear equations
1.7 Vector spaces
1.8 Linear transformations
1.9 Eigen value and Eigen vectors
1.10 The Cayley-Hamilton theorem and its uses
1.11 Diagonalization of matrices and its applications

2. Line, Surface and Volume Integrals **(12 hours)**

2.1 Line integrals
2.2 Evaluation of line integrals
2.3 Line integrals independent of path
2.4 Surfaces and surface integrals
2.5 Green's theorem in the plane and its applications
2.6 Stoke's theorem (without proof) and its applications
2.7 Volume integrals; Divergence theorem of Gauss (without proof) and its applications

3. Laplace Transform **(8 hours)**

3.1 Definitions and properties of Laplace Transform
3.2 Derivations of basic formulae of Laplace Transform
3.3 Inverse Laplace Transform: Definition and standard formulae of inverse Laplace Transform
3.4 Theorems on Laplace transform and its inverse
3.5 Convolution and related problems
3.6 Applications of Laplace Transform to ordinary differential equations

4. Fourier Series **(5 hours)**

4.1 Fourier Series

4.2 Periodic functions
4.3 Odd and even functions
4.4 Fourier series for arbitrary range
4.5 Half range Fourier series

5. Linear Programming **(9 hours)**

5.1 System of Linear Inequalities in two variables
5.2 Linear Programming in two dimensions: A Geometrical Approach
5.3 A Geometric introduction to the Simplex method
5.4 The Simplex method: Maximization with Problem constraints of the form "$\leq$"
5.5 The Dual: Maximization with Problem Constraints of the form "$\geq$"
5.6 Maximization and Minimization with mixed Constraints. The two-phase method (An alternative to the Big M Method)

References:

1. S. K. Mishra, G. B. Joshi, V. Parajuli, "Advance Engineering Mathematics", Athrai Publication.
2. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
3. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", Saunders, New York.

APPLIED MECHANICS (DYNAMICS)

CE 501

Lecture : 2 **Year : II**
Tutorial : 1 **Part : I**
Practical : 0

Course Objectives:

To provide concept and knowledge of engineering mechanics in dynamics portion to the students such that they can understand the basics of kinematics and kinetics for both particles and rigid bodies and their motion.

1. Curvilinear Motion of Particles **(4 hours)**

1.1 Position vector, velocity and acceleration
1.2 Derivatives of vector functions
1.3 Rectangular component of velocity and acceleration
1.4 Motion relative to frame in translation
1.5 Tangential and normal components
1.6 Radial and transverse components

2. Kinetics of Particles: Energy and Momentum Methods **(5 hours)**

2.1 Work done by a force
2.2 Potential and kinetic energy of particles
2.3 Principles of work and energy: applications
2.4 Power and efficiency
2.5 Conservation of energy
2.6 Principle of impulse and momentum
2.7 Impulsive motion and impact
2.8 Direct central and oblique impact

3. System of Particles **(5 hours)**

3.1 Newton's laws and a system of particles
3.2 Linear and angular moment for a system of particles
3.3 Motion of the mass centre
3.4 Conservation of momentum
3.5 Kinetic energy of system of particles
3.6 Work energy principles; Conservation of energy for a system of particles
3.7 Principles of impulse and momentum for a system of particles

3.8 Steady stream of particles
3.9 System with variable mass

4. Kinematics of Rigid Bodies (6 hours)

4.1 Introduction
4.2 Translation and rotation
4.3 General plane motion
4.4 Absolute and relative velocity in plane motion
4.5 Instantaneous centre of rotation
4.6 Absolute and relative frame; Coriolis acceleration in plane motion
4.7 Rate of change of a general vector with respect to a rotating frame; Coriolis acceleration
4.8 Motion about a fixed point
4.9 General motion
4.10 Three-dimensional motion of a particle relative to a rotating frame; coriolis acceleration

5. Plane Motion of Rigid Bodies:Forces, Moments, and Accelerations(4 hours)

5.1 Definitions: rigid bodies
5.2 Equation of motion for a rigid Body in plane motion
5.3 Angular momentum of a rigid body in plane motion
5.4 Plane motion of rigid body: D'Alembert's principle
5.5 Application of rigid body motion in the plane
5.6 Constrained motion in the plane

6. Plane Motion of Rigid Bodies: Energy and Momentum Methods (6 hours)

6.1 Principle of work and energy for a rigid body
6.2 Work done by external forces
6.3 Kinetic energy for a system
6.4 Conservative and non-conservative systems
6.5 Work – energy applications
6.6 Impulse and momentum for systems for rigid bodies
6.7 Conservation of angular and linear momentum
6.8 Impulsive motion and eccentric impact

Tutorial:

6 tutorials, 2 mini projects

References:

1. Hibbler, R.C. "Engineering Mechanics" (Statics and Dynamics)",
2. Beer F.P. and E.R. Johnson "Vector Mechanics for Engineers", Tata McGraw Hill Publishing Co. Ltd.
3. Shames, I.H "Engineering Mechanics – Statics and Dynamics"., Prentice Hall of India,New Delhi.
4. Egor .P. Popov "Engineering Mechanics of Solids", New Delhi, Prentice Hall of India.

STRENGTH OF MATERIALS
CE 502

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

Course Objectives:

To provide basic concept and knowledge of material behavior, stress-strain relations and their analysis so that students will have basic concept on theory of flexure and column buckling.

1. Axial Forces, Shearing Forces and Bending Moments (8 hours)

1.1 Plotting shearing force, bending moment and axial force diagrams for determinate structures (beams and frames)
1.2 Concept of superposition for shear forces, bending moments and axial forces due to various combinations of loads
1.3 Maximum shear force and bending moments and their positions
1.4 Relationship between loads, shear forces, bending moment

2. Geometrical Properties of Sections (7 hours)

2.1 Axes of symmetry
2.2 Centre of gravity of built-up plane figures
2.3 Centre of gravity of built-up standard steel sections
2.4 Moment of inertia of standard and built-up sections
2.5 Polar moment of inertia
2.6 Radius of gyration
2.7 Product of inertia
2.8 Principle moment and principle axes of inertia
2.9 Mohr's circle for moment of inertia

3. Simple Stress and Strain (8 hours)

3.1 Definitions: deformable Bodies, internal forces, stress, strain
3.2 Analysis of Internal forces
3.3 Simple stress and strain
3.4 Hooke's law: axial and typical stress strain diagram for characteristics of mild steel
3.5 Poisson's ratio
3.6 Stress-strain diagram
3.7 Axial stress and strain
3.8 Shear stress and strain
3.9 Shear deformation and shear angle
3.10 Hooke's law for shearing deformations
3.11 Allowable stresses and factor of safety
3.12 Stress concentrations

3.13 Relationships between elastic constants

4. Stress and Strain Analysis **(6 hours)**

4.1 Stresses in inclined plane: normal and shear stress
4.2 Principle stresses and principle planes
4.3 Relationships between normal and shear stress
4.4 Maximum shear stress and corresponding plane
4.5 Mohr's circle for stress

5. Thin Walled Vessels **(3 hours)**

5.1 Definition and characteristics of thin walled vessels
5.2 Types of stresses in thin walled vessels
5.3 Calculation of stresses in thin walled vessels

6. Torsion **(4 hours)**

6.1 Introduction and assumptions
6.2 Derivation of torsion formulas
6.3 Torsional moments in shaft
6.4 Torsional stress in shaft
6.5 Angle of twist

7. Theory of Flexure **(5 hours)**

7.1 Coplanar and pure bending
7.2 Elastic curve
7.3 Angle of rotation
7.4 Radius of curvature, flexural stiffness
7.5 Small deflection theory
7.6 Bending stress
7.7 Flexural formula, differential equation of deflected shape
7.8 Introduction to deflection

8. Column Theory **(4 hours)**

8.1 Theory of columns according to support systems
8.2 Critical load
8.3 Long column by Euler's formula
8.4 Limitations of Euler's formula
8.5 Intermediate columns; empirical formulas

Practical:

1. Stress-strain curve in tension
2. Stress-stress curve in compression
3. Torsion test to determine modulus of rigidity
4. Column behavior due to buckling
5. Deflection of simple beam

Tutorial:

8 tutorials, 2 mini projects

References:

1. Timoshenko and Gere, 'Mechanics of Materials",
2. Beer F.P. and E.R. Johnston, "Mechanics of Material",
3. E.P. Popov, "Mechanics of Material", Prentice Hall of India, New Delhi.
4. A. Pytel, F.L. Singer, 'Strength of Materials", Harper Collins, India.

ENGINEERING GEOLOGY I

CE 503

Lecture : 2 **Year : II**
Tutorial : 0 **Part :I**
Practical : 2/2

Course Objectives:

To provide concept and knowledge of geology to students of civil engineering and help them to understand how to identify the different types of rocks, minerals, geological structures, geological setting of Himalaya, geological processes and their impacts on engineering structures etc.

1. Geology and Civil Engineering **(2 hours)**

1.1 Geology and different branches of science: Introduction and their interrelationships, geology, geography, geophysics, geochemistry, geodetic, climatology, and meteorology, oceanography and astronomical aspects of the earth- moon system
1.2 Different branches of geology and their interrelations
1.3 Scope, objective and importance of geology in civil engineering
1.4 Definition of engineering geology (according to IAEG), role and tasks of an engineering geologist, scope, objectives and its importance in the context of Nepal

2. Basic Reviews of the Earth **(3 hours)**

2.1 The Earth: its origin, age, components, structure
2.2 Introduction to history of the Earth: Geological time scale, origin and evolution of life
2.3 Physical features of the earth surface: Continental & oceanic features, mountains, plateau and shields
2.4 Internal structure of the Earth
2.5 Plate tectonics and mountain building process and formation of the Himalayas

3. Crystallography & Mineralogy **(4 hours)**

3.1 Introduction and crystal morphology, symmetry elements, crystal form & habits and crystal system
3.2 Physical, chemical and optical properties of minerals
3.3 Classification and identification of common rock forming minerals

4. Petrology **(6 hours)**

4.1 Introduction: Petrology, petrography and petrogenesis
4.2 Rock and rock cycle: Introduction
4.3 Classification, structure, textures of rocks

4.4 Engineering Significance of three rock classes
4.5 Macroscopic study of rocks on the basis of physical and engineering properties of following common rock types found in earth crust: Granite, Ryhyollite, Gabbro, Basalt, Pegmatite, SyeniteShale, Siltstone, limestone, Sandstone, Conglomerate, Breccia, slate, Phyllite, Schist, Gneiss, Quartzite, Marble

5. Structural Geology **(5 hours)**

5.1 Rock deformations and reasons
5.2 Attitude of geological structures: Dip, strike, trend, plunge
5.3 Measurement of orientation of geological strata using geological maps, geological compass and plotting of data on map
5.4 Geological structures: Primary sedimentary structures (bedding plane, lamination, cross bedding, graded bedding ripple marks, mud cracks etc.)
5.5 Secondary (deformation) structures: Continuous (lineation, foliation, boudinage, crenulation cleavage, folds) and discontinuous (cracks fractures, joints, faults & thrusts)
5.6 Field identification criteria of geological structures
5.7 Engineering significance of geological structures

6. Physical Geology **(8 hours)**

6.1 Introduction: Definition, different geological agents
6.2 Geomorphological processes : Weathering and erosion
6.3 Geological cycle
6.4 Geological agents : Running water, glaciers, groundwater, wind and sea water, and various landforms produced by the geomorphological agents
6.5 Volcanism

7. Geology of Nepal **(2 hours)**

7.1 Introduction to the physiography and tectonic division of the Nepal Himalaya
7.2 Geology of the Terai Zone
7.3 Geology of the Siwalik Zone
7.4 Geology of the Lesser Himalaya Zone
7.5 Geology of the Higher Himalaya Zone
7.6 Geology of the Tethys Himalaya Zone
7.7 Study of Geological Units: Complex,group,formation,member

Practical:

1. Identification of common rock forming minerals : Quartz, Plagioclase, Orthoclase, Muccovite, Biotite, Chlorite, Calcite, Dolomite, Mangnesite, Pyroxene, Tourmaline, Pyrite, Gypsum, Talc, Fluorite, Apatite, Topaz, Corundum, Diamond, Kyanite, Silliminite, Garnet and clay minerals

2. Identification of rocks:
   Granite, Ryhyollite, Gabbro, Basalt,Pegmatite, SyeniteShale, Siltstone, Limestone, Sandstone, Conglomerate, Breccia, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble
3. Study of geological structures in block diagrams
4. Study of Maps: Topographic and geological maps, construction of geological cross-sections and their interpretations

Fieldwork **(2 Days)**

Demonstration of the use of Geological Compass for the dip/ strike and trend/ plunge measurement, Identification of rocks, study of geological structures in field (Attendance in fieldwork is compulsory)

References:

1. A. Holmes "Principles of Physical Geology",ELBS English Language Society
2. M.P. Billings "Principles of Structural Geology",Prentice Hall of India,New Delhi
3. Dr. C.K. Sharma "Geology of Nepal",Educational Enterprises
4. P.C. Ghimire and M.S. Dhar "Engineering Geology"
5. Dr. R.K. Dahal "Geology for Technical Students", Bhirkuti Publications
6. Blyth,F.G.H. , Freitas,"M.H.Geology For Engineers", ELBS

FLUID MECHANICS
CE 505

Lecture : 3 **Year : II**
Tutorial : 2 **Part : I**
Practical : 2/2

Course Objectives:

To provide basic concept and knowledge of water resources engineering and their application in the field of civil engineering. Fundamentals of fluid mechanics are taught in this semester to proceed in the application phase covered in the irrigation and hydropower engineering courses.

1. Fluid and its Physical Properties **(3 hours)**

1.1 Basic concept and definition of fluid, application in civil engineering
1.2 Shear stress in a moving fluid; difference between solids and fluids
1.3 Concept of control volume and continuum in fluid mechanics
1.4 Mass density, specific weight, specific gravity, specific volume, viscosity, compressibility, capillarity, surface tension, cavitation and vapour pressure (relations, their dimension, units as well as values for different materials)
1.5 Newton's law of viscosity causes of viscosity in liquid and gases
1.6 Variation of viscosity with temperature for different fluids
1.7 Method for finding viscosity of fluids by viscometer
1.8 Ideal and Real fluids, Newtonian and non-Newtonian fluids, compressible and incompressible fluids with examples

2. Pressure and Head **(4 hours)**

2.1 Introduction, application in civil engineering, concept about the absolute and relative equilibrium
2.2 Atmospheric, gauge and absolute pressure
2.3 Pascal's law
2.4 Hydrostatics law of pressure distribution (pressure- depth relationship)
2.5 Measurement of pressure, simple manometer as piezometer, U-tube manometer, single column vertical and inclined manometers, differential manometer, inverted U-tube differential manometer, bourden gauge

3. Hydrostatics **(10 hours)**

3.1 Pressure force and centre of pressure on submerged bodies (plane and curve surfaces)
3.2 Computation of pressure forces on gates (plane and curve), dams, retainingstructuresand other hydraulic structures; pressure diagrams
3.3 Buoyancy, flotation concept, thrust on submerged and floating bodies, hydrometer
3.4 The stability of floating and submerged bodies.

3.5 Metacentre, determination of metacentric height.
3.6 Liquid in relative equilibrium (pressure variation in the case of uniform linear and radial acceleration)

4. Hydrokinematics **(4 hours)**

4.1 Lagragian and Eulerain approaches of describing fluid flow
4.2 One, two and three dimensional flow.
4.3 Classification of fluid motion (uniform and non-uniform, steady and unsteady, laminar and turbulent)
4.4 Rotational and Irrotational motion, stream function and potential function.
4.5 Description of streamline, streak line, path line and stream tube and their drawing procedures.
4.6 Conservation principle of mass and continuity equation in Cartesian and cylindrical polar coordinates (one , two and three dimensional)

5. Hydrodynamics **(2 hours)**

5.1 Forces acting on a fluid in motion (gravitational, pressure, viscous, turbulent, surface tension, and compression forces)
5.2 Reynolds's, Euler's and Navier-Stoke's equation of motions
5.3 Development of the Euler's Equation of motion
5.4 Bernoulli's equation and its physical meaning

6. Flow Measurement **(7 hours)**

6.1 Venturimeter, orifice meter, nozzle meter and Pitot tube.
6.2 Flow through orifice (small orifice, large orifice, partially submerged orifice as well as submerged orifice)
6.3 Different hydraulic coefficients (Cv, Cc and Cd) and their determination.
6.4 Notches and Weirs(classification, discharge through rectangular, triangular trapezoidal , and Cipoletti notches, Sharp crested weir, narrow crested weir, broad crested as well as ogee shaped weirs)
6.5 Emptying and filling of reservoirs without inflow (cylindrical, hemispherical and conical), emptying and filling of reservoir with inflow (cylindrical case).
6.6 Computer programme coding for simple problems

7. Momentum Principle and Flow Analysis **(6 hours)**

7.1 Momentum principle and equations
7.2 Application of equations to calculate forces (pipe in bends, enlargements and reducers).
7.3 Forces exerted by the jet on stationary and moving vanes of different shapes.
7.4 Concept of angular momentum with examples.

8. Boundary Layer Theory **(3 hours)**

8.1 Boundary layer concept and definition.

8.2 Boundary layer concept along a thin plate (laminar zone, turbulent zone, transition zone as well as laminar sub layer)
8.3 Application of this concept (hydraulically smooth and rough boundary)
8.4 Boundary layer thickness (Boundary layer thickness, momentum thickness, and displacement thickness)

9. Flow Past Through Submerged Bodies (3 hours)

9.1 Introduction to the drag and lift forces acting on a body
9.2 Expression for drag and lift forces
9.3 Pressure and friction drag; drag coefficients
9.4 Drag on a flat plate, cylinder and sphere
9.5 Concept of aerofoil.

10. Similitude and Physical Modeling (3 hours)

10.1 Introduction to dimensional analysis (physical quantities and their dimensions)
10.2 Methods of dimensional analysis (Rayleigh and Buckingham π-Theorem)
10.3 Similitude, laws of similarity, distorted and undistorted model Physical model and modeling criteria (Reynolds, Froude, Euler, Weber and Mach's model laws with some examples.)

Practical:

The following exercises will be performed in this course. These are:
1. Hydrostatic force on submerged body
2. Stability of a floating body
3. Verification of Bernoulli's equation
4. Impact of jet
5. Flow through edged orifice
6. Flow over broad-crested weir

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials can be as following for each specified chapters.

1. Physical Properties of Fluids (3 hours)
   - Practical examples, numerical examples
2. Pressure and Head (3 hours)
   - Practical examples, numerical examples
3. Hydrostatics (6 hours)
   - Practical examples, and numerical examples
   - Use of computer programme (studied in I/I) for solving exercises
4. Hydrokinematics (2 hours)
   - Practical examples, numerical examples and derivation

5. Hydrodynamics (3 hours)
   - Practical examples, numerical examples and derivation
6. Flow measurements (4 hours)
   - Practical examples, numerical examples and derivation
   - Use of computer programme (studied in I/I) to solve some problems
7. Momentum principle and flow analysis (3 hours)
   - Practical examples, numerical examples and derivation
   - Use of computer programme (studied in I/I) to solve some problems
8. Flow past submerged bodies (2 hours)
   - Practical examples, numerical examples and derivation
9. Boundary layer theory (2 hours)
   - Practical examples, numerical examples and derivation
10. Similtude and physical modeling (2 hours)
    - Practical examples, numerical examples and derivation

References:

1. P.N. Modi and S. M. Seth "Fluid Mechanics and Hydraulics, Standard Book House.
2. Webber, N.B, "Fluid Mechanics for Civil Engineers", Chapman and Hall.
3. Victor and Street, "Elementary fluid mechanics", John Wiley and sons inc, third avenue, New York
4. D.S. Kumar "Fluid Mechanics and Fluid power Engineering", S.K. Kataria and Sons.
5. K. L. Kumar "Engineering Fluid Mechanics", Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi.
6. S Ramamrutham "Hydraulics fluid mechanics and fluid machines",. DhanpatRai Publishing Company (P) Ltd. New Delhi.
7. D. P. Sangroula "Fundamentals of Fluid Mechanics", Nepal Printing Support, Anamnagar, Kathmandu.
8. P.K. Bansal "A text book of fluid Mechanics" Laxmi Publishers.

SURVEYING I
CE 504

Lecture : 3 **Year : II**
Tutorial : 0 **Part : I**
Practical : 3

Course Objectives:

To provide basic knowledge of land measurement and surveying techniques to civil engineering students, and make them to learn and understand the theory and field procedures by applying suitable surveying methods to produce map.

1. Introduction **(3 hours)**

1.1 1.1 History of Surveying
1.2 Principle of surveying
1.3 Disciplines of surveying and their significance

2. 2. Distance Measurements **(6 hours)**

2.1 Types of Measurements
2.2 Units of measurements, System of units, significant figures, rounding of numbers
2.3 Distance measurements techniques and instruments used
2.4 Errors, type of errorsandsources of errors in making measurements,precision and accuracy,
2.5 Introduction of scales used in surveying
2.6 Various corrections for linear distance measurements

3. Chain Survey **(3hours)**

3.1 Introduction
3.2 Principle and methods of chain survey, terms used in chain surveying
3.3 Field instruction of chain survey

4. The Compass **(7 hours)**

4.1 Introduction
4.2 The Brunton Compass, The bearings, azimuth
4.3 Local attraction, magnetic declination, typical compass problem
4.4 Compass traversing, errors and adjustment
4.5 Traverse plotting

5. Leveling **(8hours)**

5.1 Introduction
5.2 Basic principle and importance of leveling
5.3 Use of hand level
5.4 Level and level rods, turning point/turning plate, rod bubbles
5.5 Two peg test

5.6 Temporary and permanent adjustment of level
5.7 Booking and calculation of reduced level
5.8 Balancing back sight and fore sight
5.9 Curvature and refraction
5.10 Classification of leveling: differential leveling, fly leveling, profile leveling
5.11 Cross sectioning, reciprocal leveling, precise leveling
5.12 Adjustment of level circuits
5.13 Sources of errors in leveling

6. Plane Table Survey **(3 hours)**

6.1 Principles and methods of plane tabling
6.2 Advantages and disadvantages of plane tabling

7. Transit and Theodolite **(5 hours)**

7.1 Basic definition
7.2 Construction principle and parts of transit and theodolite
7.3 Temporary adjustment of transit and theodolite
7.4 Reading the transit and theodolite vernier and micrometer
7.5 Measurement of horizontal and vertical angles by direction and repetition methods.
7.6 Errors in transit and theodolite
7.7 Introduction on field application

8. Triangulation and Trilateration **(4hours)**

8.1 Basic definition
8.2 Principles of triangulation and trilateration
8.3 Classification of triangulation system
8.4 Introduction on field application

9. Computation of Area and Volume **(6 hours)**

9.1 Basic definition
9.2 Area by division into simple figures
9.3 Area by coordinates, area by double-meridian distance method.
9.4 Trapezoidal rule, Simpson's 1/3 rule
9.5 Volume by average end area, prismoidal formula, prismoidal correction, curvature correction, volume by transition area.
9.6 The mass diagram, overhaul, limit of economic overhaul and determination of overhaul.

10. Measurement (EDM)

10.1 Basic Introduction
10.2 Classification of EDM instruments
10.3 Propagation of electromagnetic Energy
10.4 Principle of Electronic Distance measurement
10.5 Electro optical, microwave and total station instruments.

Field/Practical: **(45 hours)**

1. Horizontal, Vertical and slope distance measurement 3
2. Area measurement by using chain, tape and compass. 6
3. Two peg test and differential leveling 6
4. profile and cross section Leveling 9
5. Measuring horizontal and vertical angles by direction and repetition methods. 12
6. Two sets of horizontal angles by direction of a polygon figures. 3
7. EDM demo 3
8. Area measurement computation of practical No2 3

References:

1. A. Banister and S. Raymond, "Surveying", ELBS
2. Paul R. Wolf, Russel C. Brinker, " Elementary Surveying" , Harper Collins College Publishers
3. BC Punmia , "Surveying", Laxmi Publication, New Delhi
4. SK Duggal, "Surveying", Tata McGraw Hill Education Private Limited New Delhi

CIVIL ENGINEERING MATERIALS
CE 506

Lecture : 2 **Year : II**
Tutorial : 0 **Part : I**
Practical : 2/2

Course Objectives:
To provide concept and knowledge of wide range of materials (composition, manufacturing, properties, uses, etc.) that can be used in the construction and maintenance of civil engineering structures.

1. Introduction to Civil Engineering Material **(2 hours)**
- 1.1 Scope of the Subject
- 1.2 Selection Criteria of Construction Material
- 1.3 Classification of Civil Engineering Material
- 1.4 Properties of Civil Engineering Material

2. Building Stones **(3 hours)**
- 2.1 Introduction
- 2.2 Characteristics of good building stones
- 2.3 Selection and use of stone
- 2.4 Deterioration and preservation of stone
- 2.5 Natural bed of stone
- 2.6 Dressing of stone

3. Clay Products **(3 hours)**
- 3.1 Introduction
- 3.2 Constituents of brick earth
- 3.3 Manufacture of bricks
- 3.4 Good qualities of bricks
- 3.5 Classification of bricks
- 3.6 Standard test for bricks
- 3.7 Tiles and their type
- 3.8 Earthen ware and Glazing

4. Lime **(2 hours)**
- 4.1 Introduction
- 4.2 Type, Properties and Uses of lime
- 4.3 Properties and uses of Pozzolanic material

5. Cement **(4 hours)**
- 5.1 Introduction
- 5.2 Type, Properties and Uses of cement
- 5.3 Ingredients of cement
- 5.4 Manufacture of cement (Flow Diagram)

5.5 Composition and function of cement clinker
5.6 Standard test of cement
5.7 Cement water Proofers
5.8 Admixtures

6. Mortar **(2 hours)**

6.1 Introduction
6.2 Classification of mortar
6.3 Function of mortar
6.4 Selection of mortar for civil engineering works

7. Timber **(3 hours)**

7.1 Introduction
7.2 Growth and structure of tree
7.3 Classification of tree
7.4 Characteristics of good timber
7.5 Defect of timber
7.6 Seasoning of timber
7.7 Deterioration and Preservation of timber
7.8 Commercial product of Timber

8. Metals and Alloys **(4 hours)**

8.1 Introduction
8.2 Type, Properties and Uses of iron
8.3 Composition and Properties of steel
8.4 Heat Treatment Process
8.5 Alloy of Steel
8.6 Non-ferrous Metals
8.7 Commercial product of Metals

9. Paints and Varnishes **(3 hours)**

9.1 Function, ingredient, Type and Uses of Paints and Varnishes
9.2 Distemper
9.3 Anti – termite treatment

10. Asphalt, Bitumen, Tar and Miscellaneous Materials **(4 hours)**

10.1 Type, Properties and Uses of Asphalt, Bitumen and Tar
10.2 Type, Properties and Uses of glass
10.3 Plastic Materials
10.4 Insulating Materials
10.5 Gypsum Products
10.6 Composite Materials

Practical:

1. Water absorption test and bulk specific gravity test on brick sample
2. Compressive strength test of brick and stone

3. Consistency test of cement
4. Setting time test of cement (Initial and Final)
5. Fineness and Soundness test of cement
6. Compressive strength of cement

Reference:

1. Peter A. Thornton and Vito J. Colangela, "Fundamental of Engineering Materials", Prentice Hall Publishing Company.
2. Parbin Singh, "Civil Engineering Material", ,Katson Books.
3. R.K.Rajput, "Engineering Material", S. Chand & Company Ltd.

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : II

Part : II

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 552	Probability & Statistics	3	1		4	20	3	80				100	
2	AR 556	Building Drawing	1		3	4				20	3	30	50	
3	CE 551	Theory of Structures I	3	2	1	6	20	3	80	25			125	
4	CE 555	Hydraulics	4	2	1	7	20	3	80	25			125	
5	CE 554	Surveying II	3	1	3	7	20	3	80	25		25	150	
6	CE 552	Soil Mechanics	3	1	1	5	20	3	80	25			125	
7	CE 553	Engineering Geology II	2		1	3	10	1.5	40	25			75	
		Total	**19**	**7**	**10**	**36**	**110**	**16.5**	**440**	**145**	**3**	**55**	**750**	

PROBABILITY AND STATISTICS
SH 552

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 0

Course Objective:

To provide students practical knowledge of the principles and concept of probability and statistics and their application in engineering field.

1. Descriptive statistics and Basic probability **(6 hours)**

1.1 Introduction to statistics and its importance in engineering
1.2 Describing data with graphs (bar, pie, line diagram, box plot)
1.3 Describing data with numerical measure(Measuring center, Measuring variability)
1.4 Basic probability, additive Law, Multiplicative law, Baye's theorem.

2. Discrete Probability Distributions **(6 hours)**

2.1 Discrete random variable
2.2 Binomial Probability distribution
2.3 Negative Binomial distribution
2.4 Poison distribution
2.5 Hyper geometric distribution

3. Continuous Probability Distributions **(6 hours)**

3.1 Continuous random variable and probability densities
3.2 Normal distribution
3.3 Gama distribution
3.4 Chi square distribution

4. Sampling Distribution **(5 hours)**

4.1 Population and sample
4.2 Central limit theorem
4.3 Sampling distribution of sample mean
4.4 Sampling distribution of sampling proportion

5. Inference Concerning Mean **(6 hours)**

5.1 Point estimation and interval estimation
5.2 Test of Hypothesis
5.3 Hypothesis test concerning One mean
5.4 Hypothesis test concerning two mean
5.5 One way ANOVA

6. Inference concerning Proportion **(6 hours)**

6.1 Estimation of Proportions
6.2 Hypothesis concerning one proportion
6.3 Hypothesis concerning two proportion
6.4 Chi square test of Independence

7. Correlation and Regression **(6 hours)**

7.1 Correlation
7.2 Least square method
7.3 An analysis of variance of Linear Regression model
7.4 Inference concerning Least square method
7.5 Multiple correlation and regression

8. Application of computer on statistical data computing **(4 hours)**

8.1 Application of computer in computing statistical problem. eq scientific calculator, EXCEL, SPSS , Matlab etc

References:

1. Richard A. Johnson, "Probability and Statistics for Engineers", Miller and Freund's publication.
2. Jay L. Devore, "Probability and Statistics for Engineering and the Sciences", Brooks/Cole publishing Company, Monterey, California.
3. Richard I. Levin, David S Rubin, "Statistics For Management", Prentice Hall publication.
4. Mendenhall Beaver Beaver, "Introduction Probability and statistics", Thomson Brooks/Cole.

BUILDING DRAWING
AR 556

Lecture : 1 **Year : II**
Tutorial : 0 **Part : II**
Practical : 3

Course Objectives:

To provide basic terminology, component and element of building drawing with emphasis on drawing and drafting skills for floor plan, elevation, section and details of different types of building.

1. Introduction to Building and Building drawing **(1 hour)**

- 1.1 Structural system of building
- 1.2 Anatomy of building
- 1.3 Elements of building
- 1.4 Scale of building drawing

2. Symbols and Conventional Signs used for Building Drawing **(1hour)**

3. Standard Views used in Building Drawing **(5 hours)**

- 3.1 Location plan
- 3.2 Site plan
- 3.3 Floor plans
- 3.4 Elevations/Facades
- 3.5 Cross section
- 3.6 Detail drawings

4. Types of Building drawing **(7 hours)**

- 4.1 Concept drawing
- 4.2 Presentation drawing
- 4.3 Municipality drawing
- 4.4 Measured drawing
- 4.5 Working drawing
  - 4.5.1 Architect's drawing
  - 4.5.2 Structural drawing
  - 4.5.3 Service drawing
- 4.6 As built drawing

5. Introduction to Building Bye-Laws **(1 hour)**

Drawing Sheet to be prepared by the students:

S.N	Description	Sheets	hours
1	Load bearing and frame structure building, scale conversion, symbols and conventional signs	2	6

2	Floor plans	1	6
3	Elevations, cross sections	1	6
4	Details of building	2	6
5	Municipality drawing	1	6
6	Measured drawing	1	3
7	Working drawings (Architect's, structural, electrical, sanitary drawings etc)	4	12
Total		**12**	**45**

References:

1. Building Bye-laws.
2. Suraj Singh."Civil Engineering Building practice"
3. Willian J. Hornung, "Metrix Architectural construction drafting and design fundamentals",.
4. John Molnar "Building construction drafting and design"
5. Brian W. Boughton."Building and Civil engineering construction"
6. Hornung "Architectural Drafting",
7. John D. Bies. "Architectural drafting: Structure and Environment",
8. Thomas, Marvin L."Architectural Working Drawing",

THEORY OF STRUCTURES I
CE 551

Lecture : 3 **Year : II**
Tutorial : 2 **Part : II**
Practical : 2/2

Course Objectives:

To provide concept and knowledge of structural analysis with the emphasis of statically determinate structures, and make students able to perform analysis of determinate structures both by manual calculation as well as matrix method of analysis using computer application.

1. Introduction **(4 hours)**

1.1 Types of Structures Based on Material Used
1.2 Structural Mechanics
1.3 Two Basic Approaches of Structural Analysis
1.4 Linearly Elastic Structures
1.5 Non-linearity in Structural Analysis
1.6 Computer Based Methods
1.7 Principle of Superposition

2. Analysis by the Strain Energy Method **(4 hours)**

2.1 Strain Energy and Complementary Strain Energy
2.2 Strain Energy due to Gradually and Suddenly Applied Direct Load: Dynamic Multipliers
2.3 Strain Energy due to Bending, shear and Torsion

3. Analysis by the Virtual Work Method **(6 hours)**

3.1 Work and Complementary Work
3.2 Displacement of Beams and Frames by Method of Real Work
3.3 Calculation of Real Work from Bending
3.4 Limitations of the Method of Real Work
3.5 Displacements by the Methods of Virtual Work
3.6 Direct Axial and Bending Effects
3.7 Displacements in Beams due to Temperature Effects
3.8 Adjustments and Misfits in Truss Elements and Temperature Effects
3.9 Combination of Different Effects

4. Deflection of Beams **(7 hours)**

4.1 Introduction
4.2 Differential Equation of Flexure
4.3 Double Integration method
4.4 Theorems on Moment-Area Method
4.5 Macaulay's Method

4.6 Deflection of Cantilever Beams
4.7 Deflections in Simply Supported Beams
4.8 Mid-Span Deflections
4.9 Conjugate-Beam Method
4.10 Deflections by the Method of Superposition

5. Influence Lines for Simple Structures **(10 hours)**

5.1 Moving Static Loads and Influence Lines
5.2 Influence Lines for Statically Determinate structures
5.3 Moving Loads on Statically Determinate Beams
5.4 Influence Lines for Statically Determinate Trusses
5.5 Influence Line Diagrams for the Case of Indirect Load Applications (Panel Loadings)
5.6 Influence Lines for Support Reactions
5.7 Influence Lines for Support Moment
5.8 Influence Lines for Shear Force
5.9 Influence Lines for Bending Moment
5.10 Determination of Reactions, Bending Moments and Shear Forces from Influence Line Diagrams due to Different Loadings: Point Load, Distributed Load, Couple
5.11 Loading of Influence Line Diagrams using Standard Load Trains
5.12 Most Critical Position of a Load on a Beam Span

6. Statically Determinate Arches **(7 hours)**

6.1 Types of Arch
6.2 Three-Hinged Structures with Supports at the Same and different Levels
6.3 Determination of Support Reactions, Shearing Forces, Normal Forces and Bending Moments by Numerical Methods
6.4 Analysis of Three-Hinged Arches by the Graphical Method
6.5 Influence Line Diagrams for Reactions, Bending Moments, Shearing Forces and Normal Forces in Three-Hinged Arches

7. Suspension Cable Systems **(7 hours)**

7.1 Theory of Suspended Structures with Un-stiffened Cables
7.2 Catenary and Parabolic Cables
7.3 General Cases of Parabolic Cables
7.4 Elements of a Simple suspension Bridges
7.5 Stress Determination in Three-Hinged Stiffening Girder
7.6 Influence Line Diagrams
7.7 Tower structures, Wind Cables and Ties (Introduction only)

Practical:

1. Measurement of reactions in three-hinged arches under different loading arrangements
2. Deflection of Beam

3. Experimental analysis of suspension bridges
4. Simulation of Influence lines for beams and girders
5. Simulation of displacement measurement in statically determinate plane frame

Tutorial:12 assignments, 2 seminar presentations

References:

1. C.H. Norris, J.B. Wilbur and S.Utku , "Elementary structural Analysis", New York: McGraw-Hill Book Co.
2. Wong Y. Yang "Applied Numerical Methods using MATLAB", , et.Al., John Willey & Sons.
3. William Weaver, JR., james M. Gere "Matrix Analysis of Frames Structures", CBS Publishers and Distributers, India
4. A. Darkov and Kuznetsov "Structural Mechanics", Mir Publishers

HYDRAULICS
CE 555

Lecture : 4 **Year : II**
Tutorial : 2 **Part : II**
Practical : 2/2

Course Objectives:

To provide knowledge of hydraulics which aims to impart the concept of water resources engineering and their application in the field of civil engineering for the design of various hydraulic structures

1. Pipe Flow **(9 hours)**

1.1 Introduction to pipe flow, distinguish between pipe and open channel flow.
Reynolds experiment and flow based on Reynolds's number
1.2 Laminar flow (Steady uniform incompressible flow in a circular pipe, shear stress, and velocity distribution)
1.3 Head loss, Hagen Poisseuille equation.
1.4 Turbulent flow. Shear stress development, Prandtl's mixing length theory, velocity Distribution, Darcy-Weisbach equation, Nikuradse's experiments.
1.5 Resistance for commercial pipes, variation of friction factor with Reynold number, Colebrook-White equation, Moody's diagram
1.6 Minor head losses in pipes (losses in sudden enlargement, sudden contraction, Exit loss, entry loss, losses in bends and losses due to different fittings).
1.7 HGL and TEL lines

2. Simple Pipe Flow Problems and their Solutions **(5 hours)**

2.1 Three types of simple pipe flow problems and their solutions
2.2 Pipe in series, Dupuit equation. Concept of equivalent pipe length
2.3 Pipe in parallel, Different kinds of problems and their solutions
2.4 Siphons and its application
2.5 Computer programme coding for simple problems

3. Three Reservoir Problems and Pipe Networks **(6 hours)**

3.1 Introduction to three reservoir problems
3.2 Solution procedures for possible different cases
3.3 Introduction to pipe network problems and application
3.4 Hardy-Cross method of solving of pipe networks problems
3.5 Solution procedure by Hardy-Cross method for single and double loops of pipe networks with examples
3.6 Computer programme coding for simple problems

4. Unsteady Flow in Pipes **(5 hours)**

4.1 Basic equations for unsteady flow: celerity, Euler's Equation and continuity equation
4.2 water hammer and its effects
4.3 Propagation of elastic wave in rigid and elastic pipe
4.4 Pressure variation due to gradual and sudden closure of pipe Pressure variation at given point due to sudden closure of pipe.
4.5 Relief devices against water hammer (different types of surge tanks)

5. Basics of Open Channel Flow **(2 hours)**

5.1 Introduction to open channel flow and its practical application, differences between open and pipe flows
5.2 Classification (natural and artificial channel, prismatic and non-prismatic channel, rigid boundary and mobile boundary channel).
5.3 Geometric properties (depth of flow, area of flow, top width, wetted perimeter, hydraulic radius, hydraulic depth, bed or longitudinal slope, hydraulic slope, energy slope)
5.4 Classification of open channel flow (Steady unsteady; uniform non-uniform; laminar turbulent; sub-critical, super critical, critical and super critical flow; gradually varied, rapidly varied and spatially varied flow)

6. Uniform Flow in Open Channel **(7 hours)**

6.1 Condition of uniform flow, expression for the shear stress on the boundary of channel
6.2 Flow resistance equations. Darcy-Weisbach, Chezy and Manning equations and their relationship.
6.3 Determination and factors affecting manning's roughness coefficient
6.4 Velocity profile for laminar and turbulent flow, velocity distribution
6.5 Velocity distribution coefficients and their application
6.6 Conveyance, section factor, normal depth and hydraulic exponent for uniform flow computation
6.7 Problems of uniform flow computation
6.8 Best Hydraulic channel sections and determination of section dimensions (rectangular, triangular, trapezoidal and circular section)
6.9 Computer programme coding for simple problems

7. Energy and Momentum Principles in Open Channel Flow **(10 hours)**

7.1 Energy principle, specific energy, specific energy curve, criteria for critical flow
7.2 Critical depth computations for all kind of channel sections (prismatic as well as non-prismatic) and criteria for critical state of flow
7.3 Discharge depth relationship
7.4 Application of energy principle and concepts of critical depth concepts (channel width reduction, rise in channel bed, venture flume and broad crested weir)

7.5 Momentum principle, specific force, specific force curve, criteria for critical state of flow, conjugate depth
7.6 Computer programme coding for simple problems

8. Non-uniform gradually varied flow (GVF) (8 hours)

8.1 Introduction to GVF. Basic assumptions, Dynamic equation and its physical meaning
8.2 Characteristics bed slopes (mild, critical, steep, horizontal and adverse).
8.3 Characteristics and analysis of flow profiles
8.4 Computation of GVF in prismatic channels by (graphical integration, direct integration and direct step and standard step methods)
8.5 Computer programme coding for simple problems

9. Non-uniform rapidly varied flow (RVF) (4 hours)

9.1 Characteristics of RVF. Hydraulic jump as an energy dissipater
9.2 Hydraulic jump in a horizontal rectangular channel. Relationship between hydraulic jump variables (conjugate depth, height of the jump, efficiency jump, length of the jump)
9.3 Energy loss in jump
9.4 Classification of the jump based on the tail water level and Froude number
9.5 Practical application of jump at spillway toe, falls etc.
9.6 computer programme coding for simple problems

10. Flow in Mobile Boundary Channel (4 hours)

10.1 Introduction to rigid and mobile boundary channel
10.2 Rigid boundary channel and its design principle (minimum permissible velocity approach)
10.3 Definition of alluvial channel. Shear stress distribution on the channel boundary
10.4 Incipient motion condition
10.5 Design of MBC by three approaches (the permissible velocity, tractive force and regime theory approaches)
10.6 Introduction to Shied diagram and its application for designing MBC
10.7 Formation of river beds based on the shear stress

References:

1. VenTe Chow, "Open channel hydraulics". McGraw-Hill book company limited.
2. K G RangaRaju "Flow through open channel",. Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.
3. D.S. Kumar "Fluid Mechanics and Fluid power Engineering", S.K. Kataria and Sons.
4. K. L. Kumar "Engineering Fluid Mechanics", Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi.

5. S Ramamrutham "Hydraulics fluid mechanics and fluid machines",. DhanpatRai Publishing Company (P) Ltd. New Delhi.

Practical:

1. Head loss in Pipe
2. Determination of Manning's coefficient for different surfaces.
3. Flow through open sluice gate
4. Hump and constricted flow analysis
5. Hydraulic jump analysis

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorial can be as following for each specified chapters.

1. Pipe Flow **(3 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions
There will be tutorial for each sub-section

2. Simple Pipe Flow Problems and their Solution **(2 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions

3. Three Reservoir Problems and pipe Networks **(4 hours)**

Theory, definition and concept type questions
Practical examples, and numerical examples types questions
Use of computer programme(studied in I/I) for solving exercises

4. Unsteady Flow in Pipes **(3 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions
There will be tutorial for each sub-section

5. Basics of Open Channel Flow **(2 hours)**

Theory, definition and concept type questions

6. Uniform Flow **(3 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions
There will be tutorial for each sub-section
Use of computer programme (studied in I/I) to solve some problems

7. Energy and Momentum Principles in Open Channel Flow **(5hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions

There will be tutorial for each sub-section
Use of computer programme (studied in I/I) to solve some problems

8. Non-Uniform Gradually Varied Flow **(4 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions
Drawings for flow profiles
There will be tutorial for each sub-section
Use of computer programmes to solve some problems.

9. Non-Uniform Rapidly Varied Flow **(2 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions
There will be tutorial for each sub-section

10. Flow in Mobile Boundary Channel **(2 hours)**

Theory, definition and concept type questions
Practical examples, numerical examples and derivation type questions

SURVEYING II

CE 554

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 3

Course Objectives:

To provide fundamental knowledge of land measurement and modern survey application such that students will be able to implement modern survey technique in map making and application in relevant to civil engineering projects.

1. Traversing **(7 hours)**

1.1 Needs and significance of traversing
1.2 Specification for horizontal and vertical control of traverse
1.3 Field works for traversing, traverse field notes
1.4 Traverse computation for closed and link traverse, reduction of reading to angles, balancing of angles, computation of bearingsand adjustment of bearings, computation of latitudes and departures, error of closure and relative precision, balancing of consecutive coordinates, computation ofindependentcoordinates and plotting of traverse
1.5 Traverse omitted measurements
1.6 Field problems and instructions

2. Tacheometry **(5 hours)**

2.1 Principle of optical distance measurements
2.2 Stadia method, Tangential method using staff vertical and horizontal distance using subtense bar
2.3 Booking and plotting of details
2.4 Sources of errors and precision of tacheometric survey
2.5 Field problems and instructions

3. Trigonometric Leveling **(4 hours)**

3.1 Problems of heights and distances
3.2 Reciprocal trigonometrical leveling
3.3 It's signifance and error ratio
3.4 Determination of heights and distances o inaccessible objects
3.5 Instruction on field works

4. Contouring **(4 hours)**

4.1 Introduction
4.2 Establishment of controls

4.3 Contour interval and characteristics of contour
4.4 Methods of locating contours
4.5 Interpolation of contours
4.6 Uses of contour maps

5. Orientation **(4 hours)**

5.1 Introduction
5.2 Analytical intersection and resection
5.3 Two points and three point resection and their significance
5.4 Instruction on field application

6. Curves **(8 hours)**

6.1 Types of curves and their uses
6.2 Simple circular curves and their elements
6.3 Calculation and setting out of simple circular curve by ordinate from long chord, offsets from tangent and deflection angle methods
6.4 Geometry of transition curves and their elements
6.5 Elements of composite curves and setting out techniques
6.6 Equation of vertical curves and computation of reduced levels of points on curve
6.7 Instruction on field application of curves

7. Photogrammetry and Remote Sensing **(5 hours)**

7.1 Introduction of photogrammetric as a branch of surveying
7.2 Scale of vertical photograph
7.3 Relief displacement
7.4 Merits and limitation of photogrammetry
7.5 Types of remote sensing
7.6 Electromagnetic radiation
7.7 Interaction of EMR with earth surface features
7.8 Field application and instruction

8. Field Astronomy and GPS **(3 hours)**

8.1 Introduction, Definition of terms
8.2 Geographical coordinate system
8.3 Use of astronomy in surveying and mapping
8.4 Introduction of GPS
8.5 Components of GPS
8.6 Working principles and uses of GPS
8.7 Instructions to field applications

9. Total Station **(3 hours)**

9.1 Introduction
9.2 Features of Total Station
9.3 Electronic data recording
9.4 Summary of Total Station characteristics
9.5 Field procedures for Total Station in Topographical Surveying

10. Geographic Information System (GIS) **(2 hours)**

10.1 Introduction
10.2 Application of GIS to civil engineering projects

Practical Field Works: **(45 hours)**

1. Traverse survey, computation and plotting (9 hours)
2. Application of tacheometry to measure distance and elevation by using stadia system including detailing, computation and plotting (9 hours)
3. Intersection and resection using theodolite (3 hours)
4. Trigonometric leveling (3 hours)
5. Contouring – Indirect leveling (6 hours)
6. Setting out of simple circular curve, transition and vertical curve (6 hours)
7. Demonstration and application of Total Station (3 hours)
8. Demonstration and application of GPS, GIS, Photogrammetry lab visit (6 hours)

Tutorial: **(15 hours)**

1. **Traversing**
   Traverse computation i.e. including Reduction of reading to angles, balancing of angles, computation of bearings, calculation of consecutive coordinates and balancing of consecutive coordinates, calculation of independent coordinates, Findingthe missing figures of traverse

2. **Tacheometry**
   Distances and elevation computation from tacheometric observations and calculation of bearings, reduced levels and gradients from computed distances and angles

3. **Trigonometrical leveling**
   Height and distance measurement practices for distant objects by applying various cases

4. **Contouring**
   Interpolation practices from indirect method of contouring

5. **Orientation**
   Coordinates calculation of unknown points by using resection and intersection processes

6. Curves

Calculation of various elements of simple circular curves, transition curves, composite curves and vertical curves for setting out procedures

References:

1. A. Banister and S. Raymond, "Surveying", ELBS
2. Paul R. Wolf, Russel C. Brinker, "Elementary Surveying", Harper Collins College Publishers
3. BC Punmia, "Surveying", Laxmi Publication, New Delhi
4. R.Agor, "Surveying and Leveling", Khanna Publishers, Delhi
5. N NBasak, "Surveying and Leveling", Tata McGraw Hill Publishing Company Limited New Delhi
6. SK Duggal, "Surveying", Tata McGraw Hill Education Private Limited , New Delhi

SOIL MECHANICS

CE 552

Lecture : 3 **Year : II**
Tutorial : 1 **Part : II**
Practical : 2/2

Course Objectives:

To provide concepts of soil engineering, including the science and technology of soils and their application to problems in civil engineering; emphasize on fundamentals and relevant principles of soil mechanics giving an overall picture of the behavior of soils; describe the nature of some of the soil problems encountered in civil engineering.

1. Introduction **(1 hour)**

1.1 Preview of geotechnical problems in civil engineering and infrastructure development
1.2 Historical development of soil mechanics
1.3 Soil formation and soil type

2. Solids-Water-Air Relations and Index Properties of Soils **(5 hours)**

2.1 Phase diagram
2.2 Simple definitions and their relationships
2.3 Index properties of soils
2.4 Determinations of various index properties

3. Soil Identifications and Classification **(4 hours)**

3.1 Introduction
3.2 Field Identification of soil
3.3 Soil classification-Textural, ISSCS, MIT, BSCS, USCS and AASHTO soil classification system
3.4 Application of soil classification system

4. Soil Structure and Clay Minerals **(2 hours)**

4.1 Introduction
4.2 Clay minerals
4.3 Clay particle interaction
4.4 Soil structure and fabrics

5. Soil Compaction **(3 hours)**

5.1 Introduction
5.2 Laboratory tests

5.3 Factors affecting compaction
5.4 Structure and engineering behaviour of compacted cohesive soils
5.5 Compaction specification and field control

6. Principle of Effective Stress, Capillarity and Permeability **(5 hours)**

6.1 Introduction
6.2 Principle of effective stress
6.3 Physical meaning of effective stresses
6.4 Capillarity in soils
6.5 Permeability of soils
6.6 Determinations of coefficient of permeability: Laboratory and field methods
6.7 Types of head, seepage forces and quick sand conditions

7. Seepage Through Soils **(4 hours)**

7.1 Introduction
7.2 Two dimensional flow – Laplace's equation
7.3 Flow nets
7.4 Unconfined flow
7.5 Seepage in anisotropic soil condition
7.6 Seepage through an earth dam on an impervious base
7.7 Flow through non-homogeneous sections
7.8 Prevention of erosion- protective filters

8. Vertical Stresses Below Applied Loads **(4 hours)**

8.1 Introduction
8.2 Boussinesq's equation and Westergaard's equation
8.3 Vertical stress distribution diagrams
8.4 Vertical stress beneath loaded areas
8.5 New marks influence chart
8.6 Approximate stress distribution methods for loaded areas

9. Compressibility of Soil **(6 hours)**

9.1 Contact pressure and settlement profile
9.2 Fundamentals of consolidation
9.3 One-dimensional laboratory consolidation test
9.4 Voids ratio-pressure plots
9.5 Normally consolidated and over consolidated clay
9.6 Effect of disturbance on voids ratio-pressure relationship
9.7 Calculation of settlement from one - dimensional primary consolidation
9.8 Compression index and swell index
9.9 Secondary consolidation settlement

9.10 Time rate of consolidation
9.11 Coefficient of consolidation
9.12 Calculation of consolidation settlement under a foundation
9.13 Method of accelerating consolidation settlement

10. Shear Strength of Soil **(6 hours)**

10.1 Mohr-Coulomb failure criterion
10.2 Inclination of the plane of failure caused by shear
10.3 Laboratory tests For determination of shear strength parameters
10.4 Direct shear test
10.5 Triaxial shear test- general
10.6 Consolidated drained triaxial test
10.7 Consolidated undrainedtriaxial test
10.8 Unconsolidated undrainedtriaxial test
10.9 Unconfined compression test on saturated clay
10.10 Stress path
10.11 Vane shear test
10.12 Empirical relations between undrained cohesion and effective overburden pressure.
10.13 Shear strength of unsaturated cohesive soils
10.14 Shear strength of sands

11. Stability of Slopes **(5 hours)**

11.1 Introduction
11.2 Infinite slopes and translation slides
11.3 Definition of factor of safety
11.4 Finite slopes- forms of slip surface
11.5 $\phi = 0$ analysis (Total stress analysis)
11.6 $C - \phi$ analysis – method of slices
11.7 Location of the most critical circles
11.8 Friction circle method
11.9 Taylors stability number
11.10 Bishops method of stability analysis
11.11 Use of stability coefficients

Tutorial:

1. Introduction **(0.5 hours)**

2. Solids – Water - Air Relations and Index properties of soils **(1.5 hours)**

Numerical examples and derivation
There can be tutorials for each sub-section

3. **Soil Identifications and Classification** **(0.5 hours)**
   Practical examples
   There can be tutorials for each sub-section
4. **Soil Structure and Clay Minerals** **(0.5 hours)**
5. **Soil Compaction** **(1hour)**
   Practical and numerical examples
6. **Principle of Effective Stress, Capillarity and Permeability** **(2 hours)**
   Practical example and numerical examples
   There can be tutorials for each sub-section.
7. **Seepage through Soils** **(2 hours)**
   Numerical examples; Practical example
   There can be tutorials for each sub-section.
8. **Vertical Stresses Below Applied Loads** **(1 hour)**
   Numerical examples type questions.
   There can be tutorials for each sub-section.
9. **Compressibility of Soil** **(2 hours)**
   Numerical and Practical examples
10. **Shear Strength of Soil** **(2 hours)**
    Numerical and Practical examples
    There can be tutorials for each sub-section
11. **Stability of Slopes** **(2 hours)**
    Numerical and Practical examples
    There can be tutorials for each sub-section

Practical:

1. Sieve analysis of coarse and fine grained soils.
2. Determination of Atterberg limit of soils
3. Determination of In-situ density by Sand replacement method and Core Cutter Method.
4. Determination of OMC and maximum dry density
5. Unconfined compression test
6. Direct shear Test
7. Constant head permeability Test
8. UU Triaxial Test

References

1. Terzaghi K and Peck.R. B. John Wiley "Soil mechanics in Engineering Practice", New York.
2. Braja M. Das "Principles of Geotechnical Engineering", Thomson/Brookscole
3. Joseph E Bowles "Physical and Geological Properties of Soils", McGraw Hill Co. Ltd.
4. Gopal Ranjan and ASR Rao, "Basic and Applied Soil Mechanics", New Age International publishers.
5. K. R. Arora, "Soil Mechanics and Foundation Engineering" Standard Publisher Distribution.
6. S.R. Kaniraj, "Design Aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill Education Limited.
7. V.N.S. Murthy "A Text Book of Soil Mechanics and Foundation Engineering in SI units"UBS Publishers Distributors Ltd.
8. Dr. Sehgal S.B, "A Text Book of Soil Mechanics" , CBS Publishers and Distributors, New Delhi.

ENGINEERING GEOLOGY II

CE 553

Lecture : 2 **Year : II**
Tutorial : 0 **Part : II**
Practical : 2/2

Course Objectives:

To provide knowledge of Engineering Geology to the students of civil engineering and make them to understand how to measure the geological data from field for the analysis and interpretation in the development of civil infrastructures for their stability and to provide input design parameters.

1. Introduction to Engineering Geology **(3 hours)**

1.1 Engineering geological system (EGS): Rock and soils, geological structures, geomorphology, hydrogeology, weathering, earthquake & seismicity and geotechnical category of the project, evaluation of engineering geological system (EGS) with reference to the different phases (planning, design, construction and maintenance) of the infrastructure development project

1.2 Important rock forming minerals and their engineering significance

1.3 Application of engineering geology in various civil engineering projects (roads, irrigation system, tunnels, dams & reservoirs etc.)

1.4 Engineering geological maps: Their classification and preparation

2. Engineering Geology in Himalayas **(3 hours)**

2.1 Major discontinuities system of the Nepal Himalaya and their engineering significance

2.2 Major engineering geological problems of the Terai, Siwaliks, Lesser Himalaya, and the Higher Himalaya, Tibetan –Tethys zone and their mitigation

2.3 Importance of the engineering geological information system in Nepalese context

3. Hydrogeology **(2 hours)**

3.1 River channel morphology

3.2 Origin, type and movement of groundwater, porosity, permeability and hydraulic transmissivity of different rocks and sediments

3.3 Geological factors for formation of different hydrological condition

3.4 Different types of aquifer system of Nepal (Terai, hills and mountains)

4. Engineering Geology in Site Selection, Investigation & Construction/ Excavation **(5 hours)**

4.1 Introduction, types and methods

4.2 Geology in selection of the road and canal alignments

4.3 Geology in site investigation of buildings, bridges, dams and reservoirs
4.4 Geology in the selection of the tunnel and other underground structures
4.5 Engineering geological documentation during tunneling and underground excavations

5. Geological Hazards (6 hours)

5.1 Introduction
5.2 Major geological Hazards: Flood, GLOF, erosion, mass movement and their Causes
5.3 Types of mass movements
5.4 Earthquake and seismicity
5.5 Structural control on geo-hazards
5.6 Geological hazard in soil mass and rock mass
5.7 Engineering evaluation of geological hazard and risks, problem specific hazards mapping and mitigation measures

6. Measurement, Analysis and Interpretation of Structural Geological Data (8 hours)

6.1 Rockmass: Introduction, properties, classification systems
6.2 Measurement of the structural geological data from rock mass
6.3 Stereographic projection: Plotting a line & plane
6.4 Structural analysis; Principles, phases of the analysis, analysis of the structural geological data using stereo net, rose diagrams, block diagrams and histogram
6.5 Determination of the mean value of the major discontinuity sets
6.6 Interpretation of structural geological data for the specific engineering geological problems

7. Geology and Construction Materials (3 hours)

7.1 Aggregates and construction materials: clay, sand, limestone & marbles, slates & other building stones
7.2 Requirements for selecting borrow areas
7.3 Searching, exploration and reserve estimation for construction materials
7.4 Use of geological, engineering geological, and topographic maps and aerial photograph in searching of the construction materials
7.5 Application of geomorphology in searching of construction materials

Practical:

Eight practical exercises will be performed in this course, in addition to two days field works.

1. Study of engineering geological maps: Preparation, interpretation
2. Study of borehole problems
3. Study of thickness of bedrock
4. Study of construction material reserve estimate
5. Study of mineral distribution in sand using binocular microscope

6. Study and analysis of discontinuities data for failure mechanism: by stereographic projection/using Stereo net
7. Study of weathering profiles and their effect on rock mass properties
8. Exercise on rock mass classification system and their uses

Field Work (Two days)

Any one of the Road / Highway Projects under construction or have severe geo-hazard Problem / Any one of the Hydropower Projects under construction (Attendance in Fieldwork is Compulsory)

References:

1. Jonson,R.B.,Degraff,J.V, . "Principles of Engineering Geology" , John Wiley and Sons Inc
2. Hoek, "Rock Engineering",E A.A. Balkema Publishers
3. Krynione,D.P. ,Judd,W.R, "Principles of Engineering Geology and Geotechnics" CBS Publishers and Distributers,New Delhi
4. BB. Deoja,MeghrajDhital,A . Wagner,K.B. Thapa , "Mountain Risk Engineering Handbooks" , ICIMOD
5. D.G. Todd, "Ground Water Hydrology",John Wiley and Sons Inc.
6. Prof. Ando, "Engineering and Hydrogeology", Central Department of Geology,T.U.
7. Nilsen,B, "Rock Engineering"., Thidemann, NTNU
8. Dr. BishalNathUpreti and Dr. MeghrajDhital, "Landslide Studies and Management in Nepa", ICIMOD

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : III Part : I

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 603	Numerical Methods	3	1	3	7	20	3	80	50			150	
2	CE 601	Theory of Structures II	3	3		6	20	3	80	25			125	
3	CE 602	Foundation Engineering	3	1	1	5	20	3	80	25			125	
4	CE 604	Survey Camp				10 days				50		50	100	
5	CE 605	Water Supply Engineering	3	1	1	5	20	3	80	25			125	
6	CE 603	Concrete Technology and Masonry Structure	3	1	2	6	20	3	80	25			125	
7	CE 606	Engineering Hydrology	3	1	1	5	20	3	80	25			125	
		Total	**18**	**8**	**8**	**34**	**120**	**18**	**480**	**225**		**50**	**875**	

NUMERICAL METHODS

SH 603

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 3

Course objective:

To introduce numerical methods used for the solution of engineering problems. The course emphasizes algorithm development and programming and application to realistic engineering problems.

1. Introduction, Approximation and errors of computation (4hours)

1.1 Introduction, Importance of Numerical Methods
1.2 Approximation and Errors in computation
1.3 Taylor's series
1.4 Newton's Finite differences (forward , Backward, central difference, divided difference)
1.5 Difference operators, shift operators, differential operators
1.6 Uses and Importance of Computer programming in Numerical Methods.

2. Solutions of Nonlinear Equations (5 hours)

2.1 Bisection Method
2.2 Newton Raphson method (two equation solution)
2.3 Regula-Falsi Method , Secant method
2.4 Fixed point iteration method
2.5 Rate of convergence and comparisons of these Methods

3. Solution of system of linear algebraic equations (8 hours)

3.1 Gauss elimination method with pivoting strategies
3.2 Gauss-Jordan method
3.3 LU Factorization
3.4 Iterative methods (Jacobi method, Gauss-Seidel method)
3.5 Eigen value and Eigen vector using Power method

4. Interpolation (8 hours)

4.1 Newton's Interpolation (forward, backward)
4.2 Central difference interpolation: Stirling's Formula, Bessel's Formula
4.3 Lagrange interpolation
4.4 Least square method of fitting linear and nonlinear curve for discrete data and continuous function
4.5 Spline Interpolation (Cubic Spline)

5. Numerical Differentiation and Integration (6 hours)

5.1 Numerical Differentiation formulae
5.2 Maxima and minima
5.3 Newton-Cote general quadrature formula
5.4 Trapezoidal, Simpson's 1/3, 3/8 rule
5.5 Romberg integration
5.6 Gaussian integration (Gaussian – Legendre Formula 2 point and 3 point)

6. Solution of ordinary differential equations (6 hours)

6.1 Euler's and modified Euler's method
6.2 Runge Kutta methods for 1st and 2nd order ordinary differential equations
6.3 Solution of boundary value problem by finite difference method and shooting method.

7. Numerical solution of Partial differential Equation (8 hours)

7.1 Classification of partial differential equation(Elliptic, parabolic, and Hyperbolic)
7.2 Solution of Laplace equation (standard five point formula with iterative method)
7.3 Solution of Poisson equation (finite difference approximation)
7.4 Solution of Elliptic equation by Relaxation Method
7.5 Solution of one dimensional Heat equation by Schmidt method

Practical:

Algorithm and program development in C programming language of following:

1. Generate difference table.
2. At least two from Bisection method, Newton Raphson method, Secant method
3. At least one from Gauss elimination method or Gauss Jordan method. Finding largest Eigen value and corresponding vector by Power method.
4. Lagrange interpolation. Curve fitting by Least square method.
5. Differentiation by Newton's finite difference method. Integration using Simpson's 3/8 rule
6. Solution of 1st order differential equation using RK-4 method
7. Partial differential equation (Laplace equation)
8. Numerical solutions using Matlab.

References:

1. Dr. B.S.Grewal, "Numerical Methods in Engineering and Science ", Khanna Publication.

2. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis", Thomson / Brooks/cole
4. John. H. Mathews, Kurtis Fink ,"Numerical Methods Using MATLAB", Prentice Hall publication
5. JAAN KIUSALAAS , "Numerical Methods in Engineering with MATLAB", Cambridge Publication

THEORY OF STRUCTURES II
CE 601

Lecture : 3 **Year : III**
Tutorial : 3 **Part : I**
Practical : 2/2

Course Objectives:

The threefold objective of the course is to:

- Familiarize the terminologies and concepts of displacements, stresses, strains, stiffness etc. and their parameters in the context of indeterminate systems,
- Practice in examples the basic concepts and theorems on static (equilibrium), geometrical (compatibility) and physical (Force, stiffness and displacements) conditions in the context of indeterminate systems,
- Prepare the candidates for advanced courses in structural mechanics by introducing to the necessary tools like matrix method, force method, displacement method, plastic analysis etc.

1. Introduction **(8 hours)**

1.1 Formulation of problems in theory of structure: functions of the structural systems and the corresponding requirements/conditions to be fulfilled, strength, stiffness and stability of a system
1.2 Conditions and equations: static, compatibility, and physical
1.3 Satisfaction of conditions
1.4 Boundary conditions, partial restraints
1.5 Solutions of equations
1.6 Structure idealization, local and global coordinate systems and static and deformation conventions of signs
1.7 Indeterminacy of structural systems its physical meanings and its types
1.8 Degree of static indeterminacy of a system and its determination/ calculation: static indeterminacies; use of formula, necessity of visual checking: for plane systems only in the form of truss, frame and arch
1.9 Degree of kinematic indeterminacy of a system and its determination/ calculation: use of formula, necessity of visual checking: for plane systems only in the form of truss, frame and arch
1.10 Definitions and explanations of force and displacement for a structural system as operational parameters in comparison with systemic parameters like dimensions of system and elements and their material properties
1.11 Force and displacements as cause and effects; Betti's law and Maxwell's reciprocal theorem, their uses and the limitations
1.12 Two theorems from Castigliano and their applications: use of second theorem for determination of displacements in statically determinate

and solution of statically indeterminate simple systems like beam and truss

1.13 Flexibility and stiffness
1.14 Flexibility matrix
1.15 Stiffness matrix
1.16 Relationship between flexibility and stiffness matrices
1.17 Force and displacement methods

2. Force Method **(12 hours)**

2.1 Definitions and explanations; specialties of force method and its limitations
2.2 Primary systems with replacements of static indeterminacies, choice of unknowns for force quantities and its limitations, primary system with unit forces for static indeterminacies, unit force diagrams
2.3 Compatibility conditions and formulation of equations in matrix form, system specific matrix and its dependency upon choice of unknowns
2.4 Flexibility matrix: generations and calculations
2.5 Use of graphical method for calculation of coefficients (elements of flexibility matrix); derivation of formula for the standard case of parabola and straight line, its extension to the case when both are straight lines
2.6 Applications to beams and frames; three moment theorem, effects of temperature variance and settlement of supports in beams and frames, determination of redundant reactions or member forces in a beam (two to three spans) and frames (one storey two bay or two storey one bay), consideration of settlement of support, variance in internal and external temperature for beams (up to two spans) and frames (portal only) involving not more than four unknowns.
2.7 Applications to trusses; effects of temperature variance and misfits
2.8 Applications to arches (parabolic and circular): simple cases of two hinged and hinge less arches; cases of yielding of supports and temperature effects, influence line diagrams for two hinged arches
2.9 Bending moment, shear force and normal thrust diagrams for the abovementioned systems (beams, frames and arches)

3. Displacement Method **(15 hours)**

3.1 Definitions and explanations; specialties of Displacement method and its limitations
3.2 Primary system: kinematic indeterminacy and unit displacement system, unit displacement diagrams and their applications
3.3 Choice of unknowns and its uniqueness in comparison with force method
3.4 Equilibrium conditions and formulation of equations in matrix form
3.5 Stiffness matrix its formation, properties and application as system specific
3.6 Applications to beams and frames, effects of settlement of support and temperature
3.7 Applications to trusses, effect of temperature change

3.8 Bending moment, shear force and normal thrust diagrams for the systems
3.9 Fixed end moment, slope and deflection and their uses in beam systems
3.10 Equilibrium conditions of the joints in beams and frames
3.11 Slope deflection equations and their applications in beam systems
3.12 Stiffness of a member in a rigid joint
3.13 Boundary conditions
3.14 Distribution of unbalanced moment in a rigid joint
3.15 Principle of moment distribution with consideration of cross sectional stiffness, member stiffness (consideration of length) and boundary conditions
3.16 Application of moment distribution method to solve beams and frames (simple cases with one bay and two storeys or two bays and one storey)
3.17 Consideration of sway conditions(simple cases with one bay and two storeys or two bays and one storey)

4. Influence Line (IL) for Continuous Beams **(4 hours)**

4.1 Definitions and explanations: given section, structural quantity (support reaction, bending moment or shear force etc.) and the given structural system as the three basic elements of definition of IL, IL diagrams as system specific diagrams - independent of operational parameters like loads
4.2 Neutral points (focus) in an unloaded beam span of a continuous beam as fixed points with respect to load on left or right of the span, left or right focal point ratios and recurrent formula for their determination, focal point ratios for the extreme spans
4.3 Use of three moment equations and focal point ratios to determine support moments in a continuous beam
4.4 Numerical method for drawing IL diagram of support moments using focal point ratios
4.5 Use of IL of support moments to draw IL for other structural quantities like support reactions, bending moment and shear force in the given section
4.6 Mueller Breslau principle its physical meaning and its use
4.7 IL diagrams for reaction, bending moment and shear force in various sections of continuous beams (two to three spans only)
4.8 Loading of the IL diagrams, determination of reaction, bending moment and shear force at a section of a continuous beam for given loads in the form of a concentrated force, couple and distributed load

5. Introduction to Plastic Analysis **(6 hours)**

5.1 Definitions and explanations
5.2 Plastic analysis of bending members
5.3 Plastic bending
5.4 Plastic hinge and its length
5.5 Load factor and shape factor

5.6 Basic theorems on methods of limit analysis
5.7 Collapse loads: partial collapse, complete collapse
5.8 Collapse with tied loads for simple cases of statically indeterminate beams (not more than three spans) and frames (only portal frames)

Practical: **(8 hours)**

Determination of redundant reaction components and their comparative studies in the following four experiments:

1. Continuous beams (propped cantilever, two spanned beams with various end conditions)
2. Two hinged arch
3. Symmetrical portal frame
4. Unsymmetrical portal frame

References:

1. Darkov A et al., "Structural Mechanics", Mir Publishers, Moscow.
2. Ghali A, Neville A M, "Structural Analysis, A Unified Classical and Matrix Approach", Chapman and Hall.
3. Joshi H R, "Theory of Structure II - Course Manual", Institute of Engineering, Tribhuvan University, Katmandu.
4. Norris C H, Wilbur J B, Utku S, "Elementary Structural Analysis", McGraw-Hill International Editions, Civil Engineering Series.
5. Pandit G S, Gupta S P, "Structural Analysis, A Matrix Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi.
6. Reddy C S, "Basic Structural Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Wang C K, "Intermediate Structural Analysis", McGraw-Hill International Editions, Civil Engineering Series.

FOUNDATION ENGINEERING

CE 602

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

Course Objectives:

To provide basic concepts and tools that can be used to determine the structure/ foundation/ soil interactions dealing with soil mechanics principles in a variety of foundations and retaining walls.

1. Introduction **(1 hour)**

1.1 Foundation Engineering, Importance and Purpose
1.2 Classification and General Requirements
1.3 Factors Influencing the Choice of a Foundation
1.4 Selection of the Type

2. Soil Exploration **(6 hours)**

2.1 Introduction
2.2 Methods of Exploration
2.3 Planning the Exploration Program
2.4 Method of Boring
2.5 Soil Sampling and Soil Samplers
2.6 Vertical and Lateral Extent of Borings
2.7 Field Tests like Penetration Test (Standard Penetration Test, Static Cone Penetration Test, Dynamic Cone Penetration Test), Pressure Meter Tests, Dialatometer Test and Field Vane Shear Test
2.8 Ground Water Observations
2.9 Borehole Logs
2.10 Site Investigation Reports

3. Lateral Earth Pressure Theories and Retaining Walls **(10 hours)**

3.1 Introduction
3.2 Effect of Wall Movement on Earth Pressure
3.3 Earth Pressure at Rest
3.4 Classical Earth Pressure Theories
- Rankine's Theory
- Coulomb's Theory

3.5 Yielding of Wall of Limited Height
3.6 Graphical Solution for Coulomb's Earth Pressure
3.7 Trial Wedge Method for Earth Pressure

3.8 Proportioning of Retaining Walls
3.9 Stability of Retaining Walls

4. Arching in Soils and Braced Cuts **(3 hours)**

4.1 Arching in Soils
4.2 Braced Excavations
4.3 Earth Pressure against Bracings in Cuts
4.4 Heave of the Bottom of Cut in Soft Clays
4.5 Strut Loads
4.6 Deep Cuts in Sand
4.7 Deep Cut in Saturated, Soft to Medium Clays

5. Flexible Retaining Structures and Coffer Dams **(3 hours)**

5.1 Introduction
5.2 Cantilever Sheet Pile Wall
5.3 Anchored Wall
5.4 Coffer Dams

6. Bearing Capacity and Settlement of Shallow Foundations **(6 hours)**

6.1 Introduction
6.2 Basic Definitions and their Relationship.
6.3 Principle Modes of Soil Failure
6.4 Bearing Capacity by Classical Earth Pressure Theory of Rankine
6.5 Pauker and Bell's Bearing Capacity Theory of Failure
6.6 Prandtl's Theory of Failure
6.7 Terzaghi's Method of Determining Bearing Capacity of Soil
6.8 Effect of Water Table on Bearing Capacity
6.9 Extension of Terzaghi's Bearing Capacity Theory
6.10 Recent Bearing Capacity Theories
6.11 Bearing Capacity from In-situ Tests (Plate Load Test)
6.12 Types of Settlement and their Relationships
6.13 Allowable Settlement and Allowable Bearing Pressure
6.14 Steps Involved in the Proportion of Footings

7. Mat Foundations **(3 hours)**

7.1 Introduction
7.2 Common Types of Mat Foundation
7.3 Bearing Capacity and Settlement of Mat Foundations
7.4 Compensated Foundation
7.5 Analysis of Mat Foundation

8. Pile Foundations **(6 Hours)**

8.1 Introduction

8.2 Types and Uses of Piles
8.3 Construction of Piles
8.4 Selection of Pile Type
8.5 Types of Foundations to Suit Subsoil Conditions
8.6 Pile Driving Formula
8.7 Static Pile Load Formulae
8.8 Load Test on Piles
8.9 Dynamics Pile Formulae
8.10 Pile Capacity from In-situ Tests
8.11 Group Action of Piles
8.12 Negative Skin Friction
8.13 Laterally Load Piles
8.14 Piles Subjected to Uplift Loads

9. Well Foundations **(4 hours)**

9.1 Introduction
9.2 Types of Wells or Caissons
9.3 Components of a Well Foundation
9.4 Shapes of Wells
9.5 Depth of a Well Foundation
9.6 Forces acting on Well Foundation
9.7 Lateral Stability of Well Foundation
9.8 Construction and Sinking of a Well

10. Foundation Soil Improvements **(3 hours)**

10.1 Introduction
10.2 Mechanical Compaction
10.3 Dynamic Compaction
10.4 Preloading
10.5 Sand Compaction Piles and Stone Columns
10.6 Soil Stabilization by Use of Admixtures
10.7 Soil Stabilization by Injection of Suitable Grouts

Tutorial:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials can be as following for each specified chapters.

1. Introduction **(0.5 hours)**

Theory; definition and concept type questions

2. Soil Exploration **(2 hours)**

Theory; definition, numerical examples types of questions

3. **Lateral Earth Pressure Theories and Retaining Walls** **(3 hours)**

   Concept type; practical examples and numerical type questions
   There can be tutorials for each sub-section.

4. **Arching in Soils and Braced Cuts** **(1 hour)**

   Definition type; Practical example type and numerical type questions

5. **Flexible Retaining Structures and Coffer Dams** **(1 hour)**

   Definition type; Practical example type and numerical type questions

6. **Bearing Capacity and Settlement of Shallow Foundations** **(2.5 hours)**

   Concept type; definition type; Practical example type numerical examples type with diagrams questions
   There can be tutorials for each sub-section.

7. **Mat Foundations** **(1 hour)**

   Concept type; definition type; Practical example type questions
   There can be tutorials for each sub-section.

8. **Pile Foundations** **(2 hours)**

   Definition type; numerical examples type questions. Practical example type questions
   There can be tutorials for each sub-section.

9. **Well Foundations** **(1 hour)**

   Concept type; definition type; numerical examples and Practical type questions
   There can be tutorials for each sub-section.

10. **Foundations Soil Improvements** **(1 hour)**

    Concept type; definition type and Practical type questions
    There can be tutorials for each sub-section.

Practical:

Field tests on penetration test.

One observation tour of a site investigation projects and each student should prepare a brief report on the basis of prescribed data-format.

References

1. Joseph E.Bowels, "Foundation Analysis and Design" McGraw-Hill International Editions.
2. Braja M. Das, "Principles of Foundation Engineering", Thomson/Brookscole.

3. GopalRanjan and ASR Rao, "Basic and Applied soil mechanics", New Age International publishers.
4. K. R. Arora, "Soil mechanics and Foundation Engineering" Standard Publisher Distribution.
5. V.N.S. Murthy, "A Text Book of Soil Mechanics and Foundation Engineering in SI units", UBS Publishers Distributors Ltd.
6. Dr. R.K.Poudel and R.Neupane, "A Text Book of Foundation Engineering".
7. H.G.Poulos and E.H.Davis, "Pile Foundation Analysis and Design" John Wiley and Sons.

SURVEY CAMP
CE 604

Lecture : As per the requirements on the campsite **Year :III**
Tutorial : 0 **Part : I**
Practical : 10 days (10 x 13 hours) Field Works

Objectives:

The main objectives of the survey camp, which is to be scheduled during third year first part, are as under:

- To give the students an ample opportunity to consolidate and update their practical and theoretical knowledge in engineering surveying, in the actual field conditions and with practical problems.
- To provide the students real field based exposure to learn and apply different surveying methods, modern surveying instruments, computational practices and ways of presentation of their final reports. So, following field works are recommended:

A) Horizontal Control Practices for Large Area Major Traverse:

For this purpose at least 1.5 km periphery area (not less than 15-17 stations) shall be enclosed by forming the closed traverse and coordinates of those traverse points shall be controlled with reference to national grid system. X and Y coordinates shall be controlled by Total Station and Z coordinates must be controlled by Auto Level.

Time Allocated: 2 Days (Including reconnaissance, stations selection and pegging of major traverse, minor traverse, major traverse angles, distances measurement etc.)

B) Horizontal and Vertical Control for Forming Minor Traverse Inside the Major Traverse:

For this purpose detailed topographic survey shall be conducted within the perimeter of the semi built up area around 4.0 to 6.0 hectares of land (about 5-7 control points). Coordinates (XYZ) of these traverses including details shall be controlled by using Total Station and Auto level. Link traverse exercise must be compulsory.

Time Allocated: 5 Days

- 1 Day for fly leveling and RL transfer
- 2.5 Days for detailing in minor traverse
- 1.5 Days for computation and plotting of traverse

Vertical control for control points shall be done by fly leveling and detailing shall be done by using Total Station and Theodolite. Data saving in data logger (Electronics field book) and manual booking both should be practices in detailing.

C) Bridge Site Survey:

Detailed topographic survey of suitable bridge site area (200m × 120m) shall be conducted by which Topographic Map, L-section, X-section etc. shall be prepared at standard scale.

Time Allocated: 1.5 Days

Detailing shall be done by using total station. Vertical control for control points shall be done by auto level.

D) Road Alignment Survey:

At least 600m road alignment survey shall be done from where plan, L section, X section etc. shall be drawn at standard scale including selection of grades and formation levels etc.

Time Allocated: 1.5 Days

Requirements:

As far as possible, number of students for each group should not be more than 6 (six). For conducting camp as far as possible modern surveying equipment such as **Total Station, EDM, Auto level** etc. are to be used.

Evaluation Criteria:

For Internal 50 Marks:

Regular evaluation throughout the 10 days as well as viva for computation and plotting of major traverse, minor traverse, viva for road and bridge site survey and traverse orientation check should be taken.

For Final 50 Marks:

Standard Reports shall be prepared groupwise. During compilation of the report, data shall be submitted content wise and all the reference sketches and standard drawings shall be compiled in A3 size and all the original data and drawings shall be presented during final viva.

WATER SUPPLY ENGINEERING
CE 605

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

Course Objectives:

To provide concept and knowledge on the functions of the various components of the water supply system, water resources and their utilization, determination of water demand, water quality, intake construction, water treatment technology and construction of water mains and distribution.

1. Introduction **(2 hours)**

- 1.1 Importance of water
- 1.2 Definition of types of water
  - 1.2.1 Pure and impure water
  - 1.2.2 Potable and wholesome water
  - 1.2.3 Polluted and contaminated water
- 1.3 Historical development of water supply system
- 1.4 Objectives of water supply system
- 1.5 Schematic diagram of typical water supply system
- 1.6 Components of water supply system and their functions

2. Sources of Water **(4 hours)**

- 2.1 Classification of sources of water
- 2.2 Surface sources
  - 2.2.1 Rivers
  - 2.2.2 Streams
  - 2.2.3 Lakes
  - 2.2.4 Ponds
  - 2.2.5 Impounded reservoir
  - 2.2.6 Numerical on capacity determination of impounded reservoir
- 2.3 Ground sources
  - 2.3.1 Confined and unconfined aquifers
  - 2.3.2 Springs
  - 2.3.3 Wells
  - 2.3.4 Infiltration galleries and wells
- 2.4 Selection of water sources

3. Quantity of Water **(5 hours)**

- 3.1 Per capita demand of water
- 3.2 Design and base periods
  - 3.2.1 Typical design and base periods
  - 3.2.2 Selection basis
  - 3.2.3 Design and base years

3.3 Types of water demand
- 3.3.1 Domestic demand
- 3.3.2 Livestock demand
- 3.3.3 Commercial demand
- 3.3.4 Public/municipal demand
- 3.3.5 Industrial demand
- 3.3.6 Firefighting demand
- 3.3.7 Loss and wastage
- 3.3.8 Total water demand

3.4 Variation in demand of water
3.5 Peak factor
3.6 Factors affecting demand of water
3.7 Population forecasting - necessity and methods
- 3.7.1 Arithmetical increase method
- 3.7.2 Geometrical increase method
- 3.7.3 Incremental increase method
- 3.7.4 Decrease rate of growth method
- 3.7.5 Numerical on population forecasting and water demands

4. Quality of Water **(5 hours)**

4.1 Impurities in water, their classification and effects
- 4.1.1 Suspended impurities
- 4.1.2 Colloidal impurities
- 4.1.3 Dissolved impurities

4.2 Hardness and alkalinity
- 4.2.1 Types of hardness
- 4.2.2 Types of alkalinity
- 4.2.3 Relation between hardness and alkalinity
- 4.2.4 Numerical on hardness and alkalinity

4.3 Living organisms in water
- 4.3.1 Algae
- 4.3.2 Bacteria
- 4.3.3 Viruses
- 4.3.4 Worms

4.4 Water related diseases
- 4.4.1 Water borne diseases
- 4.4.2 Water washed diseases
- 4.4.3 Water based diseases
- 4.4.4 Water vector diseases
- 4.4.5 Transmission routes
- 4.4.6 Preventive measures

4.5 Examination of water
- 4.5.1 Physical examination of water(tests for temperature, color and turbidity)
- 4.5.2 Chemical examination of water (tests for pH, suspended, dissolved and total solids)

- 4.5.3 Biological examination of water(multiple tube and membrane fermentation method), most probable number
- 4.6 Water quality standard for drinking purpose

5. Intakes **(3 hours)**

- 5.1 Definition
- 5.2 Site selection of an intake
- 5.3 Classification of intake
- 5.4 Characteristics of intake
  - 5.4.1 River intakes
  - 5.4.2 Reservoir intake
  - 5.4.3 Spring intake

6. Water Treatment **(14 hours)**

- 6.1 Objectives of water treatment
- 6.2 Treatment processes and impurity removal
- 6.3 Screening
  - 6.3.1 Purpose
  - 6.3.2 Coarse, medium and fine screens
- 6.4 Plain sedimentation
  - 6.4.1 Purpose
  - 6.4.2 Theory of settlement
    - 6.4.2.1 Derivation of Stoke's law
    - 6.4.2.2 Temperature effect on settlement
  - 6.4.3 Ideal sedimentation tank
  - 6.4.4 Types of sedimentation tank
  - 6.4.5 Design of sedimentation tank
  - 6.4.6 Numerical on theory and design of sedimentation tank
- 6.5 Sedimentation with coagulation
  - 6.5.1 Purpose
  - 6.5.2 Coagulants (types and their chemical reactions)
  - 6.5.3 Mixing devices (purpose and types)
  - 6.5.4 Flocculation tanks
  - 6.5.5 Clarifier
  - 6.5.6 Jar test
- 6.6 Filtration
  - 6.6.1 Purpose
  - 6.6.2 Theory of filtration
  - 6.6.3 Types of filters
    - 6.6.3.1 Slow sand filter
    - 6.6.3.2 Rapid sand filter
    - 6.6.3.3 Pressure filter
  - 6.6.4 Numerical on dimensions and units of filters
- 6.7 Disinfection
  - 6.7.1 Purpose
  - 6.7.2 Methods of disinfection (introduction only)

- 6.7.3 Chlorination (theory, chlorine demand, chlorine dose, residual chlorine, contact time
- 6.7.4 Types of chlorine (hypochlorites, chloramines, liquid/gas chlorine)
- 6.7.5 Forms of chlorination (plain chlorination, pre chlorination, post chlorination, double chlorination, multiple chlorination, breakpoint chlorination, super chlorination, dechlorination)
- 6.7.6 Factors affecting efficiency of chlorination

6.8 Softening
- 6.8.1 Purpose
- 6.8.2 Removal of temporary hardness
  - 6.8.2.1 Boiling method
  - 6.8.2.2 Lime treatment method
- 6.8.3 Removal of permanent hardness
  - 6.8.3.1 Lime soda method
  - 6.8.3.2 Zeolite method
  - 6.8.3.3 Ionization method

6.9 Miscellaneous treatments
- 6.9.1 Aeration
  - 6.9.1.1 Purpose
  - 6.9.1.2 Methods of aeration
- 6.9.2 Removal of iron and manganese
- 6.9.3 Removal of color, odor and taste

7. Reservoirs and Distribution System **(6 hours)**

7.1 System of supply
- 7.1.1 Continuous system
- 7.1.2 Intermittent system

7.2 Clear water reservoirs

7.3 Service reservoirs
- 7.3.1 Purpose and Construction
- 7.3.2 Types of service reservoirs

7.4 Numerical on capacity determination of service reservoirs

7.5 Layout of distribution system
- 7.5.1 Tree system
- 7.5.2 Grid iron system
- 7.5.3 Ring system
- 7.5.4 Radial system

7.6 Design of distribution system
- 7.6.1 Pipe hydraulics
- 7.6.2 Design criteria
- 7.6.3 Design steps
- 7.6.4 Hard cross method

7.7 Numerical on design of branched and looped water distribution systems

8. Conveyance of Water **(3 hours)**

8.1 Pipe materials
- 8.1.1 Requirements of good material
- 8.1.2 Types of pipe material – CI, GI, steel, concrete, PVC, PPR, DI pipes

8.2 Pipe joints
- 8.2.1 Purpose
- 8.2.2 Types – socket and spigot, flanged, expansion, collar and screwed socket joints

8.3 Laying of pipes

9. Valves and Fittings **(3 hours)**

9.1 Valves
- 9.1.1 Purpose
- 9.1.2 Types – sluice, reflux, safety, air and drain valves

9.2 Fittings
- 9.2.2.1 Purpose
- 9.2.2.2 Types – stop cocks, water taps, bends, reducers, tees

9.3 Break pressure tank – purpose and construction

9.4 Public stand post
- 9.4.1 Purpose
- 9.4.2 Location
- 9.4.3 flows
- 9.4.4 Construction

9.5 Maintenance of water supply system
- 9.5.1 Necessity
- 9.5.2 Methods-regular and emergency

Practical:

1. Determination of temperature, color
2. Determination of turbidity and pH
3. Determination of suspended, dissolved and total solids
4. Determination dissolved oxygen by Winkler method
5. Determination of optimum dose of coagulant by jar test apparatus

Tutorial:

1. Introduction (1 hour)

Definitions, Schematic diagrams of typical Urban and Rural water supply systems

2. Sources of Water **(1 hour)**

Definitions, Numerical on capacity determination of impounded reservoir by analytical method

3. Quantity of Water **(2 hours)**

Definitions, Numerical on population forecasting by Arithmetical Increase Method,Geometrical Increase Method, Incremental Increase Method and

Decrease Rate of Growth Method, Numerical on determination of water demands of a community

4. Quality of Water **(2 hours)**

Definitions, Relation between hardness and alkalinity, Numerical on hardness and alkalinity, Numerical on water quality

5. Intakes **(1 hour)**

Definitions, Typical figures of River, Reservoir and Spring intakes

6. Water Treatment **(3 hours)**

Definitions, Derivation of Stoke's law of settlement, Design criteria of sedimentation tank, Numerical on theory and design of sedimentation tank, Numerical on determination of size and numbers of filters, Numerical on chlorine demand, chlorine dose and residual chlorine

7. Reservoirs and Distribution System **(3 hours)**

Definitions, Consumption pattern, Criteria of service reservoir capacity determination, Numerical on determination of service reservoir capacity, Pipe hydraulic, Design criteria of distribution systems, Derivation of flow correction by Hardy Cross Method

8. Conveyance of Water **(1 hour)**

Definitions, Typical figures of pipe joints

9. Valves and Fittings **(1 hour)**

Definitions, Typical figures of valves

References:

1. BC. Punmia, Ashok Kuamr Jain and Arun Kumar Jain, "Water Supply Engineering", Laxmi Publications (P) Ltd., New Delhi.
2. P.N. Modi, "Water Supply Engineering", Standard Book House, Delhi.
3. G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd, New Delhi.
4. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd, New Delhi.

CONCRETE TECHNOLOGY AND MASONRY STRUCTURE

CE 603

Lecture : 3 **Year : III**
Tutorial : 1 **Part : I**
Practical : 2

Course Objectives:

To provide concept, knowledge and practical information on concrete technology and masonry structures and make students able to design concrete mixes, and analyze and design masonry structures for gravity loads and lateral loads.

Part I: Concrete Technology

1. Introduction to Concrete and Concrete Materials **(4 hours)**

1.1 Use of concrete in structures and types of concrete
1.2 Concrete materials - Role of different materials (Aggregates, Cement, Water and Admixtures)
  1.2.1 Aggregates - Properties of aggregates and their gradation
  1.2.2 Cement - Manufacturing of cement, Compound composition of Portland Cement, Structure and reactivity of compounds
  1.2.3 Introduction to special types of cement
  1.2.4 Use of water in concrete
  1.2.5 Admixtures - Classification of admixtures, Introduction to commonly used admixtures (Super-plasticizer, Water proofing agent and Retarders), Use of Mineral admixtures in concrete

2. Structure of Concrete **(3 hours)**

2.1 Concrete as three phase system
2.2 Structure of aggregate phase
2.3 Structure of the hydrated cement paste phase
2.4 Transition zone in concrete

3. Mix Design of Concrete and Property of Green Concrete **(6hours)**

3.1 Workability and its test
3.2 W/C ratio in concrete
3.3 Introduction to nominal mix
3.4 Probabilistic concept in mix design approach
3.5 Concrete mix design by DOE, ACI and IS Method
3.6 Segregation and bleeding
3.7 Quality control in site: Mixing, handling, placing, compaction and curing
3.8 Concrete in extreme temperatures

4. Properties of Hardened Concrete **(3hours)**

4.1 Deformation of hardened concrete, Moduli of elasticity

4.2 Shrinkage and creep
4.3 Fatigue, impact and dynamic loading
4.4 Effect of porosity, water-cement ratio and aggregate size
4.5 Effect of gel/space ratio

5. Testing of Concrete and Quality Control (6hours)

5.1 Various strength of concrete: Tensile, Compressive, Shear and Bond
5.2 Compressive strength test
5.3 Tensile strength test
5.4 Variability of concrete strength and acceptance criteria
5.5 Non-destructing testing of concrete

6. Concrete Durability (3hours)

6.1 Effect of water and permeability on concrete durability
6.2 Physical and chemical causes of concrete deterioration
6.3 Carbonation
6.4 Corrosion of steel in concrete

Part II Masonry Structures

7. Introduction to Masonry Structures (4hours)

7.1 Use of masonry structures
7.2 Construction technology - English bond, Flemish bond, Rat-trap bond
7.3 Hollow block and compressed earth block
7.4 Masonry as infill walls
7.5 Reinforced and un-reinforced masonry

8. Design of Masonry Walls for Gravity Loads (8hours)

8.1 Introduction to codal provisions
8.2 Design example for gravity loads on:
Solid wall, wall with openings, walls with eccentric loadings and walls acting as columns

9. Masonry Structures under Lateral Loads (5hours)

9.1 Performance of masonry structures in lateral loads
9.2 Failure behavior of masonry structures in lateral loads
9.3 In-plane and out-of-plane behavior of masonry structures
9.4 Ductile behavior of reinforced and unreinforced masonry structures
9.5 Calculation of stresses for lateral loads
9.6 Elements of lateral load resisting masonry system

10. Testing of Masonry Elements (3hours)

10.1 Compressive strength of bricks and walls
10.2 Diagonal shear test
10.3 Non-destructive tests - Elastic wave tomography, Flat-jack, Push shear test and others

Practical:

Part I: Concrete Technology

1. Gradation/Properties of aggregates
2. Concrete Mix design: Nominal mix, DoE, ACI and IS Method
3. Test of concrete cubes, cylinders, prisms
4. Non-destructive testing

Part II: Masonry Structures

5. Test of bricks on Compression
6. Test of wall on Compression
7. Demonstration of Non-destructive test

References:

1. A.M. Neville, J.J. Brook, "Concrete Technology", International Students' Edition.
2. M. S. Shetty, "Concrete Technology: Theory and Practice", S. Chand, New Delhi.
3. P.K. Mehta, Paulo j. M. Monteiro, Concrete, Microstructure, Properties and Materials, University of California, Berkley (Indian Edition).
4. A.S. Arya, "Masonry and Timber Structures including Earthquake Resistant Design", Nem Chandra and Bros, Roorkee.
5. A.W. handry, B.P. Sinha, S.R. Davies, "An Introduction to Load Bearing Brick Design", University of Edinburgh.
6. P. Dayaratnam, "Brick and Reifnorced Brick Structures", Oxford and IBH Publishing Co. Pvt. Ltd.
7. IS 456, 2000.
8. IS 383, 1970.
9. IS 1905/ SP 20.
10. Nepal National Building Code (NBC) 109, 1994.

ENGINEERING HYDROLOGY

CE 606

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

Course Objectives:

To provide concept of hydrology and computational analysis for the design and management of water resources projects using practical approach with the emphasis on the application of hydrological knowledge to solve engineering problems.

1. Introduction **(2 hours)**

1.1 Definition and uses of engineering hydrology
1.2 Hydrologic cycle and water balance equations
1.3 Development of hydro-meteorological study in Nepal

2. Precipitation **(8 hours)**

2.1 Causes, forms and types of precipitation
2.2 Measurement of rainfall (types and adequacy of rain gauges)
2.3 Snow fall and its measurements
2.4 Estimation of missing rainfall data
2.5 Test for inconsistencies of rainfall data (Double mass curve)
2.6 Presentation of rainfall data (Mass curve, Hyetograph, Average curve of annual rainfall)
2.7 Estimation of mean rainfall over an area
2.8 Development of Intensity - Duration - Frequency (IDF) curve and equation
2.9 Depth - Area - Duration (DAD) curve

3. Hydrological Losses **(8 hours)**

3.1 Initial losses (Interception and depression storage)
3.2 Evaporation process
  3.2.1 Meteorological parameters (Radiation, Temperature, Vapor pressure, Humidity, Wind)
  3.2.2 Energy Budget methods and Mass transfer approach (Dalton's law)
  3.2.3 Evaporimeters
3.3 Evapotranspiration
  3.3.1 Actual evapotranspiration and Lysimeters
  3.3.2 Potential evapotranspiration (Penman's equation)
3.4 Infiltration
  3.4.1 Horton's equation
  3.4.2 Infiltration indices (Φ and W)
  3.4.3 Infiltrometers

4. Surface Runoff **(8 hours)**

4.1 Drainage basins and its quantitative characteristics
4.2 Factors affecting runoff from a catchment
4.3 Rainfall - Runoff relationship
4.4 Stream gauging (selection of sites, types of gauges and measurement)
4.5 Stream flow measurement by velocity area method (current meters, floats and velocity rods)
4.6 Stream flow computation by slope area method
4.7 Development of Rating curve and its uses
4.8 Estimation of monthly flows from rainfall

5. Hydrograph Analysis **(7 hours)**

5.1 Components of a hydrograph
5.2 Separation of base flow
5.3 Unit hydrographs, their uses and limitations
5.4 Derivation of unit hydrographs from isolated and complex storms
5.5 Derivation of unit hydrographs of different durations

6. Flood Hydrology **(7 hours)**

6.1 Design flood and its frequency
6.2 Statistical methods of flood prediction
  6.2.1 Continuous probability distribution
  6.2.2 Return period, frequency and risk
  6.2.3 Plotting positions, frequency factors
  6.2.4 Log Pearson-III Method
  6.2.5 Gumbel's extreme value type-I method
6.3 Flood prediction by rational and empirical methods

7. Flow Routing **(5 hours)**

7.1 Linear reservoir routing
7.2 Time area method
7.3 Clark unit hydrograph

Tutorial:

1. Estimation of missing rainfall data (1 hour)
2. Test for inconsistencies of rainfall data (1 hour)
3. Estimation of mean rainfall over an area by 3 methods (1 hour)
4. Estimation of Potential evapo-transpiration by Penman's equation (1 hour)
5. Use of Horton's equation and problems related to infiltration indices (1 hour)
6. Discharge computation by velocity area and slope area methods (1 hour)
7. Determination of stage at zero discharge and preparation of rating curve (1 hour)
8. Derivation of unit hydrographs from isolated and complex storms (2 hour)
9. Derivation of unit hydrographs of different durations (1 hour)
10. Drainage basin Characteristics (1 hour)

11. Estimation of design frequency of a design flood (1 hour)
12. Estimation of floods by plotting positions and distributions (1 hour)
13. Estimation of floods by Rational and Empirical methods (1 hour)
14. Flow routing and Clark UH (1 hour)

Practical:

1. Rainfall – Runoff Simulation.
2. Field visit at meteorological station.
3. Stream flow measurement by velocity area method (Current meter and Floats).
4. Stream flow measurement by dilution techniques.
5. Construction of unit hydrograph.

References:

1. Engineering Hydrology by K. Subramanya, Tata-McGraw Hill Publishing Co., New Delhi.
2. Applied Hydrology by V.T. Chow, D.R. Midment and L.W. Mays, McGraw Hill International.
3. Engineering Hydrology by R. S. Varshney, Nem Chand & Bros., Roorkee
4. Hydrology for Engineers by Linsley, Kohler and Paulhus, McGraw Hill International Co.
5. Engineering Hydrology by B. L. Gupta, Standard Publishers and Distributors, New Delhi.

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : III

Part : II

Teaching Schedule							Examination Scheme							
							Theory			Practical			Total	Remark
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Final		Assesment Marks	Final			
								Duaration hours	Marks		Duaration hours	Marks		
1	SH 651	Communication English	3	1	2	6	20	3	80	25			125	
2	CE 651	Design of Steel & Timber Structure	4	2		6	20	3	80				100	
3	CE 652	Building Technology	3	1		4	20	3	80				100	
4	CE 655	Engineering Economics	3	1		4	20	3	80				100	
5	CE 656	Sanitary Engineering	3	1		4	20	3	80				100	
6	CE 653	Transportation Engineering	3	1	1	5	20	3	80	25			125	
7	CE 654	Irrigation and Drainage Engineering	3	2		5	20	3	80				100	
		Total	**22**	**9**	**3**	**34**	**140**	**21**	**560**	**50**			**750**	

COMMUNICATION ENGLISH

SH651

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 2

Course Introduction

This course is designed for the students of engineering with the objective of developing all four skills of communication applicable in professional field.

Course Objectives:

To make students able to:

a. comprehend reading materials both technical and semi-technical in nature
b. develop grammatical competence
c. write notice, agenda, minutes
d. write proposals
e. write reports
f. write research articles
g. listen and follow instruction, description and conversation in native speakers' accent
h. do discussion in group, deliver talk and present brief oral reports

Unit I: Reading **(15 hours)**

1. Intensive Reading **(8 hours)**

1.1 Comprehension
1.2 Note-taking
1.3 Summary writing
1.4 Contextual questions based on facts and imagination
1.5 Interpreting text

2. Extensive Reading **(5 hours)**

2.1 Title/Topic Speculation
2.2 Finding theme
2.3 Sketching character

3. Contextual Grammar **(2 hours)**

3.1 Sequence of tense
3.2 Voice
3.3 Subject-Verb agreement
3.4 Conditional Sentences
3.5 Preposition

Unit II: Introduction to technical writing process and meeting **(4 hours)**

1. Editing, MLA/APA **(2 hours)**

1.1 Composing and editing strategies
1.2 MLA and APA comparison

2. Writing notices with agenda and minutes **(2 hours)**

2.1 Introduction
2.2 Purpose
2.3 Process

Unit III: Writing Proposal **(6 hours)**

1. Introduction

1.1 Parts of the proposal
- 1.1.1 Title page
- 1.1.2 Abstract/Summary
- 1.1.3 Statement of Problem
- 1.1.4 Rationale
- 1.1.5 Objectives
- 1.1.6 Procedure/Methodology
- 1.1.7 Cost estimate or Budget
- 1.1.8 Time management/Schedule
- 1.1.9 Summary
- 1.1.10 Conclusion
- 1.1.11 Evaluation or follow-up
- 1.1.12 Works cited

Unit IV: Reports **(18hours)**

1. Informal Reports **(6 hours)**

1.1 Memo Report
- 1.1.1 Introduction
- 1.1.2 Parts

1.2 Letter Report
- 1.2.1 Introduction
- 1.2.2 Parts

2. Project/Field Report **(3 hours)**

2.1 Introduction
2.2 Parts

3. Formal report **(9 hours)**

3.1 Introduction
3.2 Types of Formal Reports
- 3.2.1 Progress Report

3.2.2 Feasibility Report
3.2.3 Empirical/ Research Report
3.2.4 Technical Report
3.2.5 Parts and Components of Formal Report
3.2.5.1 Preliminary section
1.1.1.1.1. Cover page
1.1.1.1.2. Letter of transmittal/Preface
1.1.1.1.3. Title page
1.1.1.1.4. Acknowledgements
1.1.1.1.5. Table of Contents
1.1.1.1.6. List of figures and tables
1.1.1.1.7. Abstract/Executive summary
3.2.5.2 Main Section
1.1.1.1.8. Introduction
1.1.1.1.9. Discussion/Body
1.1.1.1.10. Summary/Conclusion
1.1.1.1.11. Recommendations
3.2.5.3 Documentation
1.1.1.1.12. Notes (Contextual/foot notes)
1.1.1.1.13. Bibliography
1.1.1.1.14. Appendix

Unit V: Writing Research Articles **(2 hours)**

1. Introduction

2. Procedures

Language lab		30 hours
Unit I: Listening		12 hours
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 hours
Activity II	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 hours
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 hours
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 hours
Unit II: Speaking		18 hours
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 hours

Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 hours
Activity III	Getting students to participate in group discussion on the assigned topics	4 hours
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 hours
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 hours

Evaluation Scheme

Units	Testing Items	No. of Questions	Type of Questions	Marks Distribution	Total Marks	Remarks
I	Reading	3	For grammar = objective and for the rest = short	2 Short questions 5+5 Interpretation of text 5 Note + Summary 5+5 Grammar 5	30	For short questions 2 to be done out of 3 from the seen passages, for interpretation an unseen paragraph of about 75 words to be given, for note + summary an unseen text of about 200to 250 to be given, for grammar 5 questions of fill up the gaps or transformation type to be given
II	Introduction to technical writing process and meeting	3	MLA/APA = objective, Editing and Meeting = short	MLA/APA = 4 Editing = 5 Meeting = 5	14	For APA/MLA 4 questions to be given to transform one from another or 4 questions asking to show citation according to APA/ MLA technique, For meeting minute alone or notice with agendas to be given
III	Proposal Writing	1	Long	10	10	A question asking to write a very brief proposal on any technical topic to be given
IV	Report writing	2	Informal report = short, Formal report = long	Informal report = 6 Formal report = 10	16	A question asking to write very brief informal report on technical topic to be given, for formal report a question asking to write in detail on any three elements of a formal report on technical topic to be given

V	Research article	1	Long	10	10	A question asking to write a brief research article on technical topic to be given

Evaluation Scheme for Lab

Units	Testing items	No. of Questions	Type of questions	Marks Distribution	Remarks
I	Listening · instruction · description · conversation	2	objective	5+5	listening tape to be played on any two out of instruction, description and conversation followed by 10multiple choice type or fill in the gaps type questions
II	Speaking · group/ round table discussion · presenting brief oral report · delivering talk	2	subjective	Round table discussion 5, talk or brief oral report =10	Different topics to be assigned in groups consisting of 8 members for group discussion and to be judged individually, individual presentation to be judged through either by talk on assigned topics or by brief oral reports based on their previous project, study and field visit.

Prescribed books

1. Adhikari, Usha, Yadav, Rajkumar, Yadav, Bijaya, ; " A Course book of Communicative English", Trinity Publication, 2012.
2. Adhikari, Usha, Yadav, Rajkumar, Shrestha, Rup Narayan ; "Technical Communication in English", Trinity Publication, 2012.

   (Note: 50 marks excluding reading to be covered on the basis of first book and reading part (i.e. 30 marks) to be covered on the basis of second book)
3. Khanal, Ramnath, "Need-based Language Teaching (Analysis in Relation to Teaching of English for Profession Oriented Learners)", Kathmandu: D, Khanal.
4. Konar, Nira, "Communication Skills for Professional", PHI Learning Private Limited, New Delhi.
5. Kumar, Ranjit, "Research Methodology", Pearson Education.
6. Laxminarayan, K.R, "English for Technical Communication", Chennai; Scitech publications (India) Pvt. Ltd.
7. Mishra, Sunita et. al. , "Communication Skills for Engineers", Pearson Education First Indian print.
8. Prasad, P. et. al , "The functional Aspects of Communication Skills", S.K. Kataria & sons.
9. Rutherfoord, Andrea J. Ph.D, "Basic Communication Skills for Technology", Pearson Education Asia.
10. Rizvi, M. Ashraf), "Effective Technical Communication", Tata Mc Graw Hill.

11. Reinking A James et. al, "Strategies for Successful Writing: A rhetoric, research guide, reader and handbook", Prentice Hall Upper Saddle River, New Jersey.
12. Sharma R.C. et al., "Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication", Tata Mc Graw Hill.
13. Sharma, Sangeeta et. al, "Communication skills for Engineers and Scientists", PHI Learning Private Limited, New Delhi.
14. Taylor, Shirley et. al., "Model Business letters, E-mails & other Business documents", Pearson Education.

DESIGN OF STEEL AND TIMBER STRUCTURES
CE 651

Lecture : 4 **Year : III**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:

- To make students capable to design ordinary steel and timber structures.
- To prepare students for advanced knowledge on design of complex steel and timber structures.

PART A: STEEL STRUCTURES

1. Steel Structures and their Analysis and Design **(4hours)**

1.1 Introduction to Steel Structures
1.2 Structural Steel and Classification of Steel Sections
1.3 Method of Analysis and Design
1.4 Design Process and Basis for Design

2. Working Stress Design Method **(2hours)**

2.1 Basic Assumptions in Working Stress Design
2.2 Service Load and Permissible Stresses
2.3 Design in Tension, Compression, Bending and Shear

3. Limit State Design Method **(3hours)**

3.1 Safety and Serviceability Requirements of Structure
3.2 Different Limit States for Steel Design
3.3 Design Strength of Materials and Design Loads
3.4 Limit State of Strength
3.5 Limit State of Serviceability

4. Connections in Steel Structures **(10hours)**

4.1 Types of Connections
4.2 Welded Connections
  4.2.1 Welds and Welding
  4.2.2 Design of Simple Welded Connections
  4.2.3 Design of Eccentric Welded Connections
4.3 Bolted Connections
  4.3.1 Bolts and Bolting
  4.3.2 Design of Simple Bolted Connections
  4.3.3 Design of Eccentric Bolted Connections
4.4 Introduction to Riveted Connection

5. Tension Members **(4hours)**

5.1 Types of Tension Member

5.2 Sectional Area of Tension Members
5.3 Design of Tension Members of Simple and Built-Up Sections
5.4 Design of Lug Angles
5.5 Tension Splices

6. Compression Members **(10hours)**

6.1 Types of Compression Member
6.2 Buckling Behavior of Column
6.3 Design of Column of Simple and Built-Up Sections
6.4 Design of Lateral Bracings of Compression Members
6.5 Design of Eccentrically Loaded Columns
6.6 Design of Column Bases
  6.6.1 Axially Loaded Column Bases
  6.6.2 Eccentrically Loaded Column Bases
6.7 Design of Column Splices

7. Flexure Members **(13hours)**

7.1 Types of Beams
7.2 Design of Simple Beams
7.3 Design of Built-Up Beams
7.4 Design of Plate Girders
  7.4.1 Elements of a Plate Girder
  7.4.2 Preliminary Design
  7.4.3 Design for Bending, Shear, Deflection and Lateral Stability
  7.4.4 Curtailment of Flange Plates
  7.4.5 Design of Web and Flange Splices

8. Design of Roof Trusses **(4hours)**

8.1 Types of Roof Truss and Components of Roof Truss
8.2 Loads on Roof Truss
8.3 Design of Roof Components

PART B: TIMBER STRUCTURES

9. Timber Structures and Design Methods **(2hours)**

9.1 Introduction to Timber Structures
9.2 Structural Timber and Factors Affecting the Strength of Timber
9.3 Design Methods and Basis for Design

10. Joints in Timber Structures **(2hours)**

10.1 Types of Joints
10.2 Design of Bolted Joints
10.3 Design of Nailed Joints

11. Design of Compression Members **(3hours)**

11.1 Types of Timber Column

11.2 Design of Timber Columns
11.3 Introduction to Column Bases

12. Design of Flexure Members **(3hours)**

12.1 Types of Beam
12.2 Design of Timber and Flitched Beams

Course Project:

- A Course project on integrated design of a building/industrial structure.

References:

1. S.K. Duggal, "Limit State Design of Steel Structures" Tata McGraw-Hill Publishing Com.
2. K.S. Sai Ram, "Design of Steel Structures" PEARSON Education
3. L.S. Negi, "Design of Steel Structures" Tata McGraw-Hill Publishing Com.
4. Ram Chandra, "Design of Steel Structures" Standard Book House

BUILDING TECHNOLOGY
CE 652

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:

To introduce: Functional requirements of buildings, Factors affecting comfort to the occupant in the building, Elements of building, Construction details of building components, Services in building and Causes & prevention of cracks in buildings.

1. Functional Requirements of Buildings **(7 hours)**

1.1 Buildings and their types
1.2 Heat phenomena in Building (thermal performance of building components, thermal comfort, thermal design)
1.3 Ventilation (requirements, standards, design) & air conditioning
1.4 Lighting (illumination requirements, daylight, artificial lighting)
1.5 Sound and Acoustics (sound & noise, acoustic defects, sound insulation)
1.6 Orientation & planning of buildings (principles, site-selection, economy, setting-out)
1.7 Moisture & its movement through building components and damp proofing

2. Foundations **(5 hours)**

2.1 Soil exploration (methods, improving bearing capacity, load test)
2.2 Foundation and its types (deep, shallow)
2.3 Earthwork excavation of foundations (soft soil, hard rock, wet excavation)
2.4 Excavation of trenches for pipes, cables etc. and refilling works
2.5 Some common problems with existing foundations

3. Mortars & Masonry Works **(4 hours)**

3.1 Mortars (Types, properties, preparation process, Estimating mortar requirement)
3.2 Brick masonry (types, specifications)
3.3 Stone masonry (random rubble, course rubble, ashlar)
3.4 Walls: retaining walls, cavity walls, parapet walls

4. Roofs **(4 hours)**

4.1 Roofs & their types
4.2 Timber roofs (Single/double/ multiple timber roofs)
4.3 Steel trusses and their components (Angle & tubular truss)
4.4 Roof coverings

5. Stair, Lifts and Escalators **(3 hours)**

5.1 Stair and its Elements
5.2 Essential requirements & Types of stair
5.3 Ladders, ramps, Lifts & Escalators

6. Doors and Windows **(2 hours)**

6.1 Doors: frames, shutters and their fixing details
6.2 Windows & ventilators: types and their fixing details

7. Flooring **(3 hours)**

7.1 Flooring and its types
7.2 Special types of floor finishing
7.3 Floor and wall ties

8. Temporary Construction **(4 hours)**

8.1 Scaffolding and its types
8.2 Formwork for excavations & trenches and Formworks for RCC construction
8.3 Shoring and its types
8.4 Underpinning and its procedures

9. Finishing Works **(4 hours)**

9.1 Cladding (types, fixing process)
9.2 Partitions & Suspended ceilings
9.3 Plastering & Pointing (types and process of application)
9.4 Painting works in wooden, metal and masonry surfaces

10. Causes and Prevention of Cracks in Buildings **(2 hours)**

10.1 Cracks in different components of buildings (walls, roofs, floors, plasters, windows, RCC, joints etc.)
10.2 Causes of cracks and Remedial measures to cracks

11. Earthquake Protection & Retrofitting in Building **(3 hours)**

11.1 Earthquake Protection of Buildings
11.2 Techniques of Retrofitting and Retrofitting materials
11.3 Destructive and non-destructive tests in buildings

12. Other Services in Building **(4 hours)**

12.1 Water supply & sanitation
12.2 Electrification, CCTV and Telephone network
12.3 Fire Protection
12.4 Rainwater harvesting

Assignments: **(10 marks)**

1. Drawings of site plan, foundation trench plan, section and timbering of foundation trench.

2. Detailed drawings of foundation structures. Bonding details of junction of walls.
3. Detailed drawings of important building components (foundation, plinth, and superstructure).
4. Detailing of frames and shutters of doors and windows;
5. Drawing plan and section of dog legged stair case.
6. Isometric view, plan and sections of scaffolding, shoring and underpinning.
7. Septic tank, soak pit and isometric view of pipe layout.
8. Layout drawing of power, light circuit and other networks.

Tutorial: **(15 hours)**

In tutorial class students will be taught to design a residential/office building and prepare complete working drawings with essential details.

Note:

Student will be assigned to prepare a building plan to work out detailed drawings for tutorial exercises.

References:

1. WB Mckay, "Building Construction", ELBS Publication.
2. Goyal, M. M.,"Handbook of Building Construction: The essential source of standard construction practices", Thomson Press.
3. Chudey&Greeno, "Building Construction Handbook", Butterworth & Heinemann.
4. Reid E.,"Understanding Buildings", MIT press.
5. Pahari, B., "Passive Building: Concept & Design", ISBN: 99933-34-24-3.
6. Building code (NS, IS).
7. S.C.Rangawala, "Building Construction"
8. Ching, FDK, "Building construction Illustrated"

ENGINEERING ECONOMICS
CE 655

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:
To provide concept and knowledge of economic studies that will be useful for the evaluation engineering projects and make decisions related to investment.

1. Introduction **(3 hours)**

1.1 Origin of Engineering Economy
1.2 Principles of Engineering Economy
1.3 Role of Engineers in Decision Making
1.4 Cash Flow Diagram

2. Interest and Time Value of Money **(6 hours)**

2.1 Introduction to Time Value of Money
2.2 Simple Interest
2.3 Compound Interest
  2.3.1 Nominal Interest Rate
  2.3.2 Effective Interest Rate
  2.3.3 Continuous Compounding
2.4 Economic Equivalence
2.5 Development of Interest Formulas
  2.5.1 The Five Types of Cash Flows
  2.5.2 Single Cash Flow Formulas
  2.5.3 Uneven Payment Series
  2.5.4 Equal Payment Series
  2.5.5 Linear Gradient Series.
  2.5.6 Geometric Gradient Series.

3. Basic Methodologies of Engineering Economic Analysis **(8 hours)**

3.1 Determining Minimum Attractive (Acceptable) Rate of Return (MARR).
3.2 Payback Period Method
3.3 Equivalent Worth Methods
  3.3.1 Present Worth Method
  3.3.2 Future Worth Method
  3.3.3 Annual Worth Method
3.4 Rate of Return Methods
  3.4.1 Internal Rate of Return Method.
  3.4.2 External/Modified Rate of Return Method
3.5 Public Sector Economic Analysis (Benefit Cost Ratio Method)
3.6 Introduction to Lifecycle Costing
3.7 Introduction to Financial and Economic Analysis

4. Comparative Analysis of Alternatives **(6 hours)**

4.1 Comparing Mutually Exclusive Alternatives having Same Useful Life by
- 4.1.1 Payback Period Method and Equivalent Worth Method
- 4.1.2 Rate of Return Methods and Benefit Cost Ratio Method

4.2 Comparing Mutually Exclusive Alternatives having Different Useful Lives by
- 4.2.1 Repeatability Assumption
- 4.2.2 Co-terminated Assumption
- 4.2.3 Capitalized Worth Method

4.3 Comparing Mutually Exclusive, Contingent and Independent Projects in Combination

5. Replacement Analysis **(6 hours)**

5.1 Fundamentals of Replacement Analysis
- 5.1.1 Basic Concepts and Terminology
- 5.1.2 Approaches for Comparing Defender and Challenger

5.2 Economic Service Life of Challenger and Defender

5.3 Replacement Analysis When Required Service Life is Long
- 5.3.1 Required Assumptions and Decision Framework
- 5.3.2 Replacement Analysis under the Infinite Planning Horizon
- 5.3.3 Replacement Analysis under the Finite Planning Horizon

6. Risk Analysis **(6 hours)**

6.1 Origin/Sources of Project Risks

6.2 Methods of Describing Project Risks
- 6.2.1 Sensitivity Analysis
- 6.2.2 Breakeven Analysis
- 6.2.3 Scenario Analysis

6.3 Probability Concept of Economic Analysis

6.4 Decision Tree and Sequential Investment Decisions

7. Depreciation and Corporate Income Taxes **(6 hours)**

7.1 Concept and Terminology of Depreciation

7.2 Basic Methods of Depreciation
- 7.2.1 Straight line method
- 7.2.2 Declining Balance Method
- 7.2.3 Sinking Fund Method
- 7.2.4 Sum of the Year Digit Method
- 7.2.5 Modified Accelerated Cost Recovery System (MACRS)

7.3 Introduction to Corporate Income Tax

7.4 After Tax Cash Flow Estimate

7.5 General Procedure for Making after Tax Economic Analysis

8. Inflation and its Impact on Project Cash Flows **(4 hours)**

8.1 Concept of Inflation

8.2 Measuring Inflation

8.3 Equivalence Calculation Under Inflation
8.4 Impact of Inflation on Economic Evaluation

Tutorial:

1. Assignments
2. Quizzes and 1Case study

References:

1. Chan S.Park,"Contemporary Engineering Economics", Prentice Hall, Inc.
2. E. Paul De Garmo, William G. Sullivan and James A. Bontadelli, "Engineering Economy", Mc Milan Publishing Company.
3. James L. Riggs, David D. Bedworth and Sabah U. Randhawa, "Engineering Economics", Tata McGraw Hill Education Private Limited.

SANITARY ENGINEERING
CE 656

Lecture : 3 **Year : III**
Tutorial : 1 **Part : II**
Practical : 0

Course Objectives:

To provide a complete knowledge of wastewater on collection, conveyance, treatment, disposal methods and design including knowledge of sludge and solid waste management

1. Introduction **(2 hours)**

- 1.1 Definitions of common terms - Sewage/Wastewater, Domestic sewage, Industrial sewage, Sanitary sewage, Storm water, Sullage, Sewer, Sewerage, Rubbish, Garbage, Refuse/Solid waste
- 1.2 Importance of Wastewater and Solid Waste Managements
- 1.3 Wastewater and Solid waste management methods - Collection, Conveyance, Treatment and Disposal
- 1.4 Objectives of sewage disposal
- 1.5 Sanitation systems
  - 1.5.1 Conservancy system with merits and demerits
  - 1.5.2 Water carriage system with merits and demerits
- 1.6 Sewerage systems and types
  - 1.6.1 Separate system
  - 1.6.2 Combined system
  - 1.6.3 Partially separate system
  - 1.6.4 Comparison between separate and combined systems

2. Quantity of Wastewater **(4 hours)**

- 2.1 Dry Weather Flow (DWF) and Wet Weather Flow (WWF)
- 2.2 Sources of sanitary sewage
  - 2.2.1 Private and public water supplies
  - 2.2.2 Groundwater infiltration
  - 2.2.3 Unauthorized connections
- 2.3 Factors affecting quantity of sanitary sewage
  - 2.3.1 Population
  - 2.3.2 Rate of water supply
  - 2.3.3 Groundwater infiltration
  - 2.3.4 Unauthorized connections
- 2.4 Determination of quantity of sanitary sewage, peak factor, peak flow
- 2.5 Determination of quantity of storm water
  - 2.5.1 Rational method and its limitation
  - 2.5.2 Overall runoff coefficient
  - 2.5.3 British ministry of Health formula for intensity of rainfall
  - 2.5.4 Time of concentration

2.6 Numerical on determination of quantity of wastewater for separate, combined and partially separate systems

3. Design and Construction of Sewers **(4 hours)**

3.1 Design criteria of sewers
- 3.1.1 Specific gravity of wastewater
- 3.1.2 Design period
- 3.1.3 Minimum and Maximum velocities, Self-cleansing velocity
- 3.1.4 Sewer size range
- 3.1.5 Sewer gradient
- 3.1.6 Hydraulic formulae for design - Manning's, Chezy's and Hazen Williams formulae
- 3.1.7 Hydraulic elements of sewers for partial flow condition
- 3.1.8 Partial flow diagrams

3.2 Shapes of sewers - Circular and non-circular sections with merits and demerits

3.3 Sewer Materials
- 3.3.1 Requirements of sewer materials
- 3.3.2 Types of sewer materials - salt glazed stoneware, cement concrete, cast iron

3.4 Design of sewers of separate and combined systems

3.5 Numerical on design of sewers

3.6 Construction of sewers
- 3.6.1 Setting out
- 3.6.2 Alignment and gradient
- 3.6.3 Excavation of trench
- 3.6.4 Timbering of trench
- 3.6.5 Dewatering of trench
- 3.6.6 Laying and jointing
- 3.6.7 Testing of sewer - Straightness, Obstruction, Water and Air tests
- 3.6.8 Backfilling of trench

4. Sewer Appurtenances **(3 hours)**

4.1 Necessity of sewer appurtenances

4.2 Construction of sewer appurtenances
- 4.2.1 Manhole
- 4.2.2 Drop manhole
- 4.2.3 Lamp hole
- 4.2.4 Street inlets
- 4.2.5 Catch basin
- 4.2.6 Flushing device
- 4.2.7 Sand, grease and oil traps
- 4.2.8 Inverted siphon
- 4.2.9 Sewer outlet
- 4.2.10 Ventilating shaft

5. Characteristics and Examination of Wastewater **(5 hours)**

5.1 Characteristics of wastewater
- 5.1.1 Physical characteristics - colour, odour, temperature and turbidity
- 5.1.2 Chemical characteristics - pH, organic and inorganic solids, nitrogenous compounds
- 5.1.3 Biological characteristics – bacteria

5.2 Sampling of wastewater
- 5.2.1 Grab and composite samples
- 5.2.2 Preservation and storing

5.3 Decomposition of wastewater-process, Aerobic and anaerobic decomposition, Stale sewage

5.4 Biochemical Oxygen Demand (BOD)
- 5.4.1 Definition of BOD and its significance
- 5.4.2 Derivation of BOD equation
- 5.4.3 Rate reaction, ultimate BOD and relation with temperature
- 5.4.4 Numerical on BOD

5.5 Chemical oxygen Demand (COD) - Definition and significance

5.6 Examination of wastewater
- 5.6.1 Necessity of wastewater examination
- 5.6.2 Examination of volatile, fixed and total solids, settleable and non-settleable solids,BOD with and without dilution, COD

5.7 Numerical on BOD test

6. Wastewater Disposal **(6 hours)**

6.1 Necessity and objectives of wastewater disposal

6.2 Wastewater disposal methods - Dilution and Land treatment

6.3 Wastewater disposal by Dilution process and essential conditions fordilution

6.4 Self-purification of rivers/streams

6.5 Factors affecting self-purification - Dilution, Current, Sunlight, Sedimentation, Temperature, Oxidation, Reduction

6.6 Oxygen sag curve

6.7 Streeter Phelp's equation (Derivation not required)

6.8 Numerical on self-purification of rivers/streams

6.9 Wastewater disposal by land treatment
- 6.9.1 Suitability of land treatment
- 6.9.2 Methods of land treatment - irrigation, overland flow and rapid infiltration
- 6.9.3 Broad irrigation and sewage farming
- 6.9.4 Methods of application of sewage on land - flooding, surface irrigation, ridge and furrow method, subsurface irrigation and spray irrigation
- 6.9.5 Sewage sickness and its prevention

7. Wastewater Treatment **(12 hours)**

7.1 Objectives of wastewater treatment

7.2 Treatment process types and impurity removal

7.3 Primary treatment process
- 7.3.1 Racks and Screens - purpose and types (Bar, Coarse andFine screens)
- 7.3.2 Skimming tank - purpose and construction
- 7.3.3 Grit chamber - purpose, construction and design criteria
- 7.3.4 Sedimentation - purpose, types and design criteria
- 7.3.5 Chemical precipitation - purpose, mixing and flocculation (introduction only)
- 7.3.6 Numerical on design of Grit chamber and Sedimentation tank

7.4 Biological (Secondary) treatment process
- 7.4.1 Objectives of biological treatment process
- 7.4.2 Principles of biological treatment process - Attached andSuspended growth processes
- 7.4.3 Types of biological treatment process

7.5 Sewage filtration
- 7.5.1 Filter types
- 7.5.2 Intermittent sand filter - purpose, construction,working and cleaning with merits anddemerits
- 7.5.3 Contact bed - purpose, construction, working and cleaning with merits and demerits
- 7.5.4 Trickling filter - purpose, construction, working andcleaning with merits and demerits,types (high rate and standard rate), recirculation, two stage filters, design criteria
- 7.5.5 Numerical on design of trickling filters

7.6 Activated sludge process
- 7.6.1 Principles of activated sludge process
- 7.6.2 Construction and process description
- 7.6.3 Aeration methods
- 7.6.4 Design criteria
- 7.6.5 Advantages and disadvantages
- 7.6.6 Sludge volume index
- 7.6.7 Numerical on activated sludge process

7.7 Oxidation ponds
- 7.7.1 Purpose of oxidation ponds
- 7.7.2 Theory of oxidation ponds
- 7.7.3 Construction of oxidation ponds
- 7.7.4 Commissioning
- 7.7.5 Operation and maintenance
- 7.7.6 Design criteria
- 7.7.7 Advantages and disadvantages
- 7.7.8 Numerical on oxidation ponds

8. Sludge Treatment and Disposal **(4 hours)**

8.1 Sources of sludge
8.2 Necessity of sludge treatment
8.3 Characteristics of sludge
8.4 Determination of sludge volume, volume - moisture relation

8.5 Sludge treatment methods
- 8.5.1 Grinding and blending
- 8.5.2 Thickening - Gravity thickener, purpose, constructionand loading criteria
- 8.5.3 Digestion - Aerobic and anaerobic digestion, digestionprocess, control of digestion,construction and design criteria of digester
- 8.5.4 Dewatering - Vacuum filtration (purpose and construction)
- 8.5.5 Drying - Sludge drying beds (purpose and construction)
- 8.5.6 Composting - purpose, principles, types (windrow and mechanical)
- 8.5.7 Incineration - purpose and construction

8.6 Numerical on sludge volume determination and design of digester

8.7 Sludge disposal methods
- 8.7.1 Dumping
- 8.7.2 Land filling
- 8.7.3 Lagooning
- 8.7.4 Spreading on land

9. Disposal of Sewage from Isolated Buildings **(3 hours)**

9.1 Necessity

9.2 On site sanitation - Definition and types

9.3 Pit privy - purpose and construction

9.4 Ventilated Improved Pit (VIP) latrine - purpose, construction,design criteria, types (single pit, double pits and multiple pits), advantagesand disadvantages

9.5 Pour flush latrine - purpose, construction and design criteria

9.6 Septic tank - purpose, construction, design criteria, working and maintenance

9.7 Septic tank effluent disposal methods
- 9.7.1 Drain field - purpose, construction and design criteria
- 9.7.2 Soak pit - purpose, construction and design criteria
- 9.7.3 Evapotranspiration mound - purpose and construction
- 9.7.4 Leaching cesspool - purpose and construction

9.8 Numerical on design of VIIP latrine, Pour flush latrine, Septic tank,Drain field and Soak pit

10. Solid Waste Disposal **(2 hours)**

10.1 Characteristic of solid waste

10.2 Quantity of solid waste

10.3 Collection and transportation of solid waste

10.4 Solid waste disposal methods
- 10.4.1 Dumping
- 10.4.2 Sanitary landfill
- 10.4.3 Incineration
- 10.4.4 Composting

Tutorial:

1. Quantity of Wastewater **(2 hours)**

Definitions, Numerical on determination of sanitary sewage and storm water, determination on quantity of wastewater for separate, combined and partially

separate systems

2. **Design and Construction of Sewers / Sewer Appurtenances (2 hours)**
   Design criteria of sewers, partial flow conditions in sewers, Numericalon design of sewers for separate and combined systems
3. **Characteristics and Examination of Wastewater (2 hours)**
   Definitions, Numerical on BOD and BOD testing
4. **Wastewater Disposal (2 hours)**
   Definitions, Streeter-Phelp'sequation description, Numericalonpurificationofrivers/streams and degree of treatment required
5. **Wastewater Treatment (3 hours)**
   Definitions, Numerical on grit chamber, sedimentation tank,trickling filter, activated sludgeprocess and oxidation pond
6. **Sludge Treatment and Disposal (2 hours)**
   Definitions, Numerical on sludge volume determination, volume-moisture relation and design ofdigesters
7. **Disposal of Sewage from Isolated Buildings/ Solid Waste Disposal (2 hours)**
   Definitions, Numerical on design of VIP latrine, Pour flush latrine, Septic tank, Drain fieldand Soak pit

References:

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

TRANSPORTATION ENGINEERING I

CE 653

Lecture : 3
Tutorial : 1
Practical : 2/2

Year : III
Part : II

Course Objectives:

To provide knowledge of road development and its planning based on Nepalese context so that students will be able to plan, survey and design the road projects.

1. Introduction to Transportation Planning and Engineering (4 hours)

- 1.1 Introduction
- 1.2 Modes of Transportation
- 1.3 Comparison between Various Modes of Transportation
- 1.4 Historical Development of Roads and Road Construction in Nepal
- 1.5 Transport Planning including Objective of Road Planning, National Network Planning, Urban Road Network Planning and Ring Roads
- 1.6 Classification of Roads (NRS)

2. Highway Alignment and Engineering Survey (4 hours)

- 2.1 Highway Alignment
  - 2.1.1 Introduction
  - 2.1.2 Requirements of Highway Alignment
  - 2.1.3 Factors Controlling Highway Alignment
- 2.2 Engineering Survey and its Stages
  - 2.2.1 Structure of the Route Location Process
  - 2.2.2 Physical Surveys: Map Study, Reconnaissance, Preliminary and Detailed Surveys

3. Geometric Design of Highway (18 hours)

- 3.1 Definition and Scope of Geometric Design
- 3.2 Basic Design Controls and Criteria for Design
- 3.3 Elements of Cross-section
- 3.4 Elements of Horizontal Alignments
  - 3.4.1 Definition and Types of Horizontal Curve
  - 3.4.2 Design of Horizontal Curves including Night Visibility Consideration
  - 3.4.3 Sight Distance: Stopping Sight Distance, Overtaking Sight Distance, Set-back from Obstructions
  - 3.4.4 Super Elevation
  - 3.4.5 Extra Widening
  - 3.4.6 Transition Curves: Definition and Types of Transition Curve, Design of Transition Curve
- 3.5 Elements of Vertical Alignment
  - 3.5.1 Definition and Types of Gradient

3.5.2 Momentum Grade
3.5.3 Grade Compensation
3.5.4 Definition and Types of Vertical Curve
3.5.5 Design of Vertical Summit Curve
3.5.6 Design of Vertical Valley Curve
3.5.7 Lowest and Highest Point of Vertical Curve

4. Highway Drainage **(4 hours)**

4.1 Introduction and Importance of Highway Drainage System
4.2 Causes of Moisture Variation in Sub-grade Soil
4.3 Surface Drainage System
4.3.1 Different Types of Road Side Drain
4.3.2 Cross Drainage Structures (Culverts and Others)
4.3.3 Different Types of Energy Dissipating Structures
4.4 Subsurface Drainage System
4.4.1 Drainage of Infiltrated Water
4.4.2 Control of Seepage Flow
4.4.3 Lowering of Water Table
4.4.4 Control of Capillary Rise

5. Hill Roads **(5 hours)**

5.1 Introduction
5.2 Special Consideration in Hill Road Design
5.2.1 Alignment of Hill Road Design: General Consideration, Route Location in Hills, Gradient, Design and Types of Hair Pin Bends, Different Types of Hill Road Cross Sections
5.3 Special Structures in Hill Road
5.3.1 Types of Retaining Structures, River Training Structures, Land Slide Stabilization Structures and Gully Control Structures

6. Highway Materials **(10 hours)**

6.1 Introduction and Classification of Road Materials
6.2 Sub-grade Soil
6.2.1 General
6.2.2 Characteristics of Sub-grade Soil
6.2.3 Desirable Properties of Sub-grade Soil
6.3 Road Aggregate
6.3.1 Definition and Classification of Road Aggregates
6.3.2 Desirable Properties of Road Aggregates
6.3.3 Tests on Road Aggregates and their Significance
6.3.4 Comparing Gradation Specification and Method of Translating Specification
6.3.5 Combining of the Aggregates
6.4 Bituminous Road Binders
6.4.1 Definition and Classification of Road Binders
6.4.2 Liquid Bitumen: Cut-back Bitumen and Bitumen Emulsion

6.4.3 Tests on Bituminous Binders

6.5 Bituminous Mixes

6.5.1 Definition and Classification

6.5.2 Marshal Method of Bitumen Mix Design

Tutorial:

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

Practical:

1. Los Angeles Abrasion Value and Crushing Value of Aggregates
2. Penetration Value; Viscosity; Softening Point and Ductility of Bitumen
3. Skid Resistance Test on Road Surface
4. Marshall Stability Test and Asphalt Mix Design
5. Extraction of Bitumen from Mix and Gradation of Aggregate after Extraction

References:

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

IRRIGATION AND DRAINAGE ENGINEERING

CE 654

Lecture : 3 **Year :III**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:

To provide knowledge to students for the planning, design, development, operation, maintenance & management and demand analysis of irrigation, methods of irrigation, components of an irrigation system and layout of irrigation structures.

1. Introduction **(4 hours)**

1.1 Definition, advantages and disadvantages of irrigation
1.2 Status and need of irrigation development in Nepal
1.3 Crops, their seasons and periods (Cropping pattern & intensity)
1.4 Commanded areas and Irrigation intensity
1.5 Methods of field irrigation and their suitability
1.6 Planning of irrigation projects

2. Irrigation Water Requirements **(4 hours)**

2.1 Relation between Duty, Delta and crop periods
2.2 Crop Water Requirements (Penman's method)
2.3 Operational water requirements
2.4 Water losses due to seepage and evaporation
2.5 Effective Rainfall
2.6 Irrigation Water Requirements
2.7 Soil-Moisture-Irrigation Relationship
2.8 Depth and Frequency of Irrigation
2.9 Irrigation efficiencies
2.10 Design discharges for canals

3. Canal Irrigation System **(3 hours)**

3.1 Classification of canals
3.2 Components of a canal irrigation system
3.3 Alignment of canals
3.4 Alluvial and Non-alluvial canals
3.5 Canal standards and Balancing canal depth
3.6 Canal distribution system

4. Design of Canals **(6 hours)**

4.1 Design capacity of canals
4.2 Sediment transport in canals
4.3 Tractive Force approach of canal design

4.4 Design of stable canals
4.5 Design of Alluvial canals (Kennedy's &Lacey's Theory)
4.6 Design of lined canals with economic analysis

5. Diversion Headworks **(8 hours)**

5.1 Component parts of Weir/Barrage (Detail drawing)
5.2 Bligh's, Lane's and Khosla's seepage theory
5.3 Design of sloping glacies weir bay (crest, length & thickness of impervious floor)
5.4 Design of Undersluice and Silt excluder
5.5 Design of Silt ejector
5.6 Design of Head Regulator (Crest, length & thickness of impervious floor)

6. River Training Works **(4 hours)**

6.1 River stages and Need of river training
6.2 Types of river training works
6.3 Design of Guide bunds and Launching apron
6.4 Design of Spurs (Layout geometry, length, spacing and cross-section)

7. Regulating Structures **(6 hours)**

7.1 Alignment of the off-taking channels
7.2 Function of Head regulator, Cross regulator, Outlet, Drop and Escapes
7.3 Design of Regulators & Escapes (Crest, length and thickness of impervious floor)
7.4 Types of Outlet, Design of pipe outlet (free and submerged)
7.5 Types of Drop, Design of Vertical drop (Crest, length and thickness of impervious floor)

8. Cross-Drainage Structures **(4 hours)**

8.1 Types (Drawing and Selection)
8.2 Design of Siphon Aqueduct (Detail drawing, Drainage waterway & barrel, Canal waterway & Transition, Length & thickness of impervious floor and Protection works)

9. Water Logging and Drainage **(6 hours)**

9.1 Causes, effects and preventive measures of water logging
9.2 Water logging and drainage of irrigated land
9.3 Surface drainage systems and their design
  9.3.1 Layout planning for Drainage
  9.3.2 Internal drainage of Bunded fields
  9.3.3 External drainage
  9.3.4 Drain design (water level, maximum & minimum slopes and cross-sections)
  9.3.5 Remodeling of existing natural drains
9.4 Subsurface drainage systems and their design
  9.4.1 Layout of subsurface drainage system

9.4.2 Flow of ground water to drains and spacing of tile drains

Tutorial: **(30 hours)**

1. Duty, Delta and Period Relation (1 hour)
2. Irrigation Water Requirements (2 hours)
3. Soil-Moisture-Irrigation Relation and Irrigation Interval (2 hours)
4. Balancing depth for excavating canals (1 hour)
5. Design of stable canals (1 hour)
6. Design of Alluvial canals (2 hours)
7. Design of lined canals (1 hour)
8. Design of Guide Bunds and Launching Apron (2 hours)
9. Design of hydraulic structures using Khosla's Seepage Theory (4 hours)
10. Design of sloping glacies Weir bay (2 hours)
11. Design of Cross & Head Regulators (3 hours)
12. Design of pipe outlet (1 hour)
13. Design of Vertical Drop (2 hours)
14. Design of Siphon Aqueduct (4 hours)
15. Design of surface and sub-surface drains (2 hours)

Assignment& Field Visit:

1. Individual assignment on Irrigation Water Requirement using CROPWAT Software
2. Field visit of an Irrigation System, group presentation and submission of individual report

References:

1. R S Varshney, S C Gupta and R L Gupta, "Theory and Design of Irrigation Structures Volume I and II", , Nem Chand and Bros., Roorkee.
2. S K Garg, "Irrigation Engineering and Hydraulic Structures", Delhi.
3. Gurcharan Singh, " Irrigation Engineering",
4. "Design Manuals for Irrigation projects in Nepal", PDSP Manuals, M.9 Drainage Manual
5. P. Novak et.al., "Hydraulic Structures", SPON PRESS.

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : IV

Part : I

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

PROJECT ENGINEERING
CE 701

Lecture : 3
Tutorial : 1
Practical : 0

Year : IV
Part : I

Course Objective:

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

Course Outlines:

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

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

2. Project Appraisal and Project Formulation (8 hours)

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

3. Project Planning and Scheduling (12 hours)

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

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

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

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

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

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

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

6.1 Project finance
6.2 Capital Structure Planning
6.3 Capital Budgeting Decision

Tutorial:

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

References:

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

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

DESIGN OF REINFORCED CONCRETE STRUCTURES
CE 702

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

Course Objective:

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

1. Concrete Structures and Design Methods (3 hours)

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

2. Working Stress Method of Design (4 hours)

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

3. Limit State Method of design (5hours)

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

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

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

5. Design for Shear and Torsion (4hours)

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

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

6.1 Development length
6.2 Anchorage bond

6.3 Flexural bond

7. Reinforcement detailing: Codal Provisions (4hours)

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

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

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

9. Design of slabs and staircase (6hours)

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

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

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

11. Design of Footings (6hours)

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

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

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

Tutorial:

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

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

Project work:

Individual project to and design elements of a low rise building

Practical:

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

References:

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

TRANSPORTATION ENGINEERING II
CE 703

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

Course Objective:

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

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

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

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

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

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

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

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

2.1 Definition and Types of Pavements

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

3. Road Construction Technology (8 hours)

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

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

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

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

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

Tutorial:

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

Practical:

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

References:

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

HYDROPOWER ENGINEERING
CE 704

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

Course Objectives:

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

1. Introduction **(4 hours)**

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

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

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

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

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

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

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

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

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

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

6. Water Conveyance Structures (8 hours)

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

7. Hydro-electricMachines (6 hours)

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

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

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

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

8. Powerhouse **(2 hours)**

8.1 Powerhouse types, general arrangement, dimension of powerhouse

Tutorial:

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

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

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

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

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

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

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

Practical:

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

Excursion:

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

References:

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

ESTIMATING AND COSTING

CE 705

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

Course objective:

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

1. Introduction **(3 hours)**

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

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

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

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

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

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

4.1 Introduction
4.2 Purpose of Rate Analysis

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

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

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

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

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

Tutorial: **(15 hours)**

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

References:

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

PROJECT WORK – I
CE 707

Lecture : 0
Tutorial : 0
Practical : 3

Year : IV
Part : I

Course Objective:

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

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

A project may involve:

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

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

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

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

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

ELECTIVE I

STRUCTURAL DYNAMICS

CE 72501

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

Tutorial/Practical:

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

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

References:

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

SEISMIC RESISTANT DESIGN OF MASONRY STRUCTURES

CE 72502

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

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

Tutorial:

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

Practical / Project Work:

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

References:

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

TRAIL SUSPENSION BRIDGE

72503

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

Course Objectives

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

1. Introduction **(2 hours)**

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

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

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

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

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

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

4.1 Rate Analysis
4.2 Cost Estimate

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

5.1 Construction Planning

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

Tutorial:

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

Practical:

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

References:

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

BIO-ENGINEERING

CE 72504

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

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

6.1 Vegetative engineering systems
6.2 Design of vegetative techniques

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

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

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

8.1 Site categorization
8.2 Selection of optimal technique

9. Nursery **(4 hours)**

9.1 Nursery establishment
9.2 Nursery technique

10. Management **(1 hour)**

10.1 Importance of seasonal programming

Tutorial:

Detail Analysis of slope stability

Practical:

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

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

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

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

References:

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

ROCK ENGINEERING

CE 72505

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

Course Objectives:

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

1. Background **(1 hour)**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

10.1 Introduction
10.2 Underground high-Pressure Tunnels and Shafts

Tutorial:

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

Practical:

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

Field Visit: **(2 days)**

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

References:

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

SOIL CONSERVATION AND WATERSHED MANAGEMENT
CE 72506

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

Course Objectives:

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

1. Introduction **(2 hours)**

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

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

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

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

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

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

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

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

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

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

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

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

6.1 Contour and Staggered Trenching

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

6.3 Sediment Retention Structures

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

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

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

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

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

8. Water Conservation and Harvesting (7 hours)

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

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

8.3 Recharge and Use of Ground Water

9. Watershed Management (6 hours)

9.1 Causes and Consequences of Watershed Deterioration

9.2 Objectives and Steps of Watershed Management

9.3 People's Participation in Watershed Management

9.4 Watershed Management Plan (WMP)

9.5 Formulation of Project Proposal

Tutorial:

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

Practical/Assignment:

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

References

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

EARTH HAZARD

CE 72507

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

Course Objectives:

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

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

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

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

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

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

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

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

4. Earthquakes **(4 hours)**

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

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

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

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

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

Tutorial:

Detail analysis of Landslide hazard.

Practical:

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

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

Reference:

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

TRANSPORTATION PLANNING AND ENGINEERING
CE 72509

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

Course Objectives:

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

1. Introduction **(6hours)**

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

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

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

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

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

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

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

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

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

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

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

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

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

7.1 Introduction
7.2 Gravity goods ropeways
7.3 Existing planning process

Tutorial:

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

Practical/assignment:

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

References:

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

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

ROPEWAY ENGINEERING

CE 72510

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

Course Objectives:

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

1. Introduction **(2 hours)**

1.1 Historical Background of Ropeway Transport
1.2 Ropeway in Nepal

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

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

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

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

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

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

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

5.1 Rate Analysis
5.2 Cost Estimate

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

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

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

7.1 Material Testing
7.2 Safety Measures

Tutorial:

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

Project work:

Design of a gravity ropeway system.

Field work:

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

References:

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

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

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

SOLID WASTE MANAGEMENT
CE 72511

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

Course Objectives:

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

1. Introduction **(4 hours)**

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

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

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

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

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

3.8 Transfer and Transport of MSW
3.9 Transfer Stations

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

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

5. Resource Recovery (10 hours)

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

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

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

Tutorial:

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

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

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

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

Practical/Field Visit:

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

References:

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

WATER AND WASTEWATER QUALITY ANALYSIS

CE 72512

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

Course Objective:

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

1. Introduction **(2 hours)**

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

2. Sampling **(6 hours)**

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

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

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

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

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

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

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

5.1 Coliforms
5.2 E - coli

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

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

Tutorial:

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

Practical:

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

References:

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

COMMUNITY DEVELOPMENT AND PARTICIPATORY RURAL APPROACH

CE 72513

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

Course Objectives:

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

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

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

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

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

3. Communication **(10 hours)**

3.1 Art of communication;
3.2 Paraphrasing

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

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

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

Tutorial:

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

Practical / Project work:

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

References:

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

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

B.E. DEGREE
IN
CIVIL ENGINEERING

Year : IV

Part : II

Teaching Schedule							Examination Scheme							
							Theory			Practical				
								Final			Final			
S. N.	Course Code	Course Title	L	T	P	Total	Assesment Marks	Duaration hours	Marks	Assesment Marks	Duaration hours	Marks	Total	Remark
1	CE 751	Computational Techniques in Civil Engineering	3	2		5	20	3	80				100	
2	CE 752	Engineering Professional Practice	2			2	10	1.5	40				50	
3	CE 753	Technology Environment & Society	2			2	10	1.5	40				50	
4	CE 754	Construction Management	4	2		6	20	3	80				100	
5	CE 755	Project II			6	6				50		50	100	
6	CE 765	Elective II	3	1	1.5	5.5	20	3	80	25			125	
7	CE 785	Elective III	3	1	1.5	5.5	20	3	80	25			125	
		Total	**17**	**6**	**9**	**32**	**100**	**15**	**400**	**100**		**50**	**650**	

COMPUTATIONAL TECHNIQUES IN CIVIL ENGINEERING

CE 751

Lecture : 3 **Year : IV**
Tutorial : 2 **Part : II**
Practical : 0

Course Objective:

To provide knowledge of numerical solutions and computational techniques of various civil engineering problems related to structural and water resources engineering and their computer implementation using algorithms and 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, Lame 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 elements
  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 Lagragian element
  4.3.4 Hermite interpolation for beam element
  4.3.5 Serendipidity 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
4.5 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

Tutorial:

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

1. Introduction (2 hours)

Theory, definition and concept type questions
Practical: Home work to make programs in C or FORTRAN or Matlab languages

2. Solutions of linear equations (6 hours)

Theory, definition and concept type questions
Practical examples, and numerical example type questions
Write algorithm and computer programs to solve the problems

3. Elasticity in solid (2 hours)

Theory, definition and concept type questions
Practical examples of various conditions of stresses

4. Finite element method (FEM) (10 hours)

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, exercises 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, exercises on Seepage under dam and River stage –Water table evaluation

Assignment:

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 equations.

References:

1. P. Karasudhi, "Foundation of Solid Mechanics", Kluwer Acedemic Publishers.
2. O. C. Zienkiewicz, R. L. Taylor, "Finite Element for Structural, Vol. 1, 2 & 3", Elsevier.
3. D. V. Huttan, "Fundamentals of Finite Element Analysis", TATA McGRAW-HILL.

4. T. R. Chandrapatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI.
5. W. H. Press, S. A. Teukolsky, W. T. Vetterling, B. P. Flannery, "Numerical Recipes in C, The Art of Scientific Computing", 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", 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

ENGINEERING PROFESSIONAL PRACTICE

CE 752

Lecture : 2 **Year : IV**
Tutorial : 0 **Part : II**
Practical : 0

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.

Course Outlines:

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

TECHNOLOGY ENVIRONMENT AND SOCIETY

CE 753

Lectures : 2 **Year : IV**
Tutorials : 0 **Part : II**
Practical : 0

Course Objectives:

To provide knowledge of environment, technology and its impact on society in order 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 air pollution
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 and 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"

CONSTRUCTION MANAGEMENT

CE 754

Lecture : 4 **Year : IV**
Tutorial : 2 **Part : II**
Practical : 0

Course Objectives:

- 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 Materials **(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 Equipment **(7 hours)**

4.1 Advantages and Disadvantages of using Equipment
4.2 Equipment 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

Tutorial:

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",

PROJECT WORK-II

CE 755

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

ELECTIVE II

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

CE 76501

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

Course Objectives:

To understand the nature of earthquakes, behavior of structures under the ground motion, and learns 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 hazardanalysis (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 homework 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.
2. Kramer, S. L., "Geotechnical Earthquake Engineering", Prentice -Hall.
3. Dowrick D., "Earthquake Resistant Design and Risk Reduction", John Wiley & Sons.
4. Chopra A. K., "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Prentice Hall.
5. Clough R. W., Penzien J, "Dynamics of Structures", McGraw Hill.

DESIGN OF BRIDGES

CE 76502

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

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.

References:

1. Victor, D.J, "Essential of Bridge Engineering", Oxford and IBH Publishing Company, New Delhi.
2. Rakshit, R.S, "Design and Construction of Highway Bridges", New Central Book Agency, New Delhi
3. Swami Saran, "Analysis and Design of Substructures", Oxford and IBH

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

GEOTECHNICAL EARTHQUAKE ENGINEERING
CE 76503

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

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

Tutorial:

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)**

Theory, Definition and Concept Type Questions
Examples of recurrences relationship and hazard assessment

5. Site Amplification and Ground Response Analysis **(2 hours)**

Theory, definition and concept type questions
Practical examples of site response analysis

6. Liquefaction (2 hours)

Theory, definition and concept type questions
Practical examples of liquefaction problems

7. Seismic Slope Stability **(2 hours)**

Theory, definition and concept type questions
Practical examples of earth pressure problems

Project:

1. Seismology and earthquakes, single degree of freedom systems
2. Strong ground motion parameters and response analysis
3. Site amplification and dynamic soil properties
4. 1-D equivalent linear site response with computer program
5. Analysis of seismic hazards (Liquefaction and seismic slope stability)

References:

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

VULNERABILITY ASSESSMENT AND RETROFITTING TECHNIQUES

CE 76504

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

Course Objectives:

The course provides practical information on vulnerability assessment of existing buildings and retrofitting techniques. 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 test

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 involvethe 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. Hari DarshanShrestha et all, "Manual On Vulnerability Assessment and Retrofitting of Existing School Buildings", Prevention web
7. NEHRP Guidelines for the Seismic Rehabilitation of Buildings, FEMA 273

8. Nepal National Building Code (NBC) 109, 1994
9. Dr B .Vidivelli, "Rehabilitation of Concrete Structures", Standard Publisher 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

SEISMIC RISK ASSESSMENT
CE 76505

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

Course Objectives:

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

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

STRUCTURAL RELIABILITY
CE 76506

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

Course Objectives:

The objective of this course is to provide knowledge of probabilistic design of civil engineering structures. This course includes the fundamentals of statistics and its application to 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

Tutorial:

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 be related practical assignment.

References:

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

ROCK SLOPE ENGINEERING

CE 76507

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

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:

Two days field visit to potential unstable slopes.
Note: Field report and group presentation is necessary

References:

1. Hoek, E. and Bray, J. W. , " 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://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 92 - 104.

3. Hoek, E. 1998 , "Development of Rock Engineering (Chapter 1)". Course notes, Internet edition http://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 1 - 17.

4. Hoek, E. 1998. "Factor of Safety and Probability of Failure (Chapter 8)". Course notes, Internet edition, http://wwwrockeng.utronto.ca/hoekcorner.htm, pp. 105 - 114.

5. Hoek, E. 2000, "Shear Strength of Discontinuities (Chapter 4)". Course notes, Internet edition. http://wwwrockeng.utronto.ca/hoekcorner.htm, pp.60-72.

HILL IRRIGATION ENGINEERING
CE 76508

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

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

Tutorial:

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)

Assignment/Practical:

Individual assignment on design of Sprinkler and Drip irrigation systems.

References:

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

GROUNDWATER ENGINEERING
CE 76509

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

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, tube-well 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, Theis 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)

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

Tutorial:

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 work:

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. H. M. Raghunath, "Groundwater", New Age International Publishers.
2. David Keith Todd, "Groundwater Hydrology".
3. Jacob Bear, "Hydraulics of Groundwater", McGraw-Hill, Inc.

4. Department of Interior, Bureau of Reclamation, "Handbook of Groundwater Development", John Wiley & Sons. U.S.
5. "Study of Groundwater Development: Strategies for Irrigation in the Terai, Volume 3", Groundwater, Groundwater Development Consultants (International) Limited, Cambridge, United Kingdom.
6. "Groundwater Management Project in the Kathmandu Valley. Final report", Main report. Japan International Cooperation Agency. 1990.

TRAFFIC AND TRANSPORT MODELING
CE 76510

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

Course Objectives:

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)

Tutorial:

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

ROCK MECHANICS
CE 76511

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

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 **(7hours)**

- 4.1 Modes of failures of rock
- 4.2 Common lab strength tests
- 4.3 σ-ε behavior in compression
  - 4.3.1 σ-ε
  - 4.3.2 hydraulic compression
  - 4.3.3 deviatoric compression
  - 4.3.4 effect of σ_3
- 4.4 Meaning of rock strength
- 4.5 σ-ε 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 Anistrophic rocks

5. Initial Stresses in Rocks and their Measurement **(7hours)**

- 5.1 Influence of the initial stresses
- 5.2 Estimating the initial stresses

5.2.1 horizontal stresses
5.2.2 vertical stresses
5.2.3 horizontal stresses direction
5.3 Techniques for measurements of In-situ stresses
5.3.1 hydraulic fracturing
5.3.2 flat jack method
5.3.3 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
7.3.1 lab compression test
7.3.2 plate bearing test
7.3.3 borehole and gallery test
7.3.4 radial jacking test
7.3.5 flat jack test
7.3.6 dynamic measurement
7.3.7 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 sloes
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. B.M. Das, "Principles of Geotechnical Engineering", Boston PWS Engineering.
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 Intnl.Conf. on Rock Mech. And Strata Control. New York, 140-152.
4. Leeman, E.R, "Remote Measurement of Rock Stress under Development in Rock Mechanics",
5. Leeman, E.R., "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 Intnl. Cong. on Rock Mechanics. Lisbon.

ADVANCED GEOTECHNICAL ENGINEERING

CE 76512

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

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 Deformations
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 geosysthetics and preparation of report.

References:

1. B.M. Das, "Principles of Geotechnical Engineering" , Boston PWS Engineering, 1985
2. M. R. Housmann, "Engineering Principles of Ground Modifications" ,. McGraw-Hill Co.
3. R. Bowen, "Grouting in Engineering Practice", Allied Science Pub. , London.

TRAFFIC ENGINEERING AND MANAGEMENT

CE 76513

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

Course Objectives:

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

Tutorial:

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, "Traffic Engineering", Prentice Hall.
2. Papacostas, C. S, "Fundamentals of Transportation Engineering", Prentice Hall.

3. Kadiyali, LR , "Traffic Engineering and Transportation Planning", Khanna Publishers.
4. "Highway Capacity Manual", Transportation Research Board, USA.
5. Khanna, S. K. and Justo, C. E. G, "Highway Engineering", Nemchand.

RURAL ROAD ENGINEERING

CE 76514

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

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 Curves
3.6 Super Elevation
3.7 Extra-Widening 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 Bio-engineering
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. B.C.Huchinson, "Principles of Urban Transport Planning" , McGraw Hill publishing company.
2. E. K. Morlok, "Introduction to transportation engineering and planning", International Student Edition, McGraw Hill publishing company.
3. V. N. Vazirani and S.P.Chandola , "Transportation Engineering Volume I and II", Khanna Publishers, Delhi, India

DOMESTIC WATER&WASTE WATER ENGINEERING AND MANAGEMENT

CE 76515

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

Course Objectives:

To provide knowledge 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

Tutorial:

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 work:

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, "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

CLIMATE CHANGE
CE 76516

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

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_2
- 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 fossilfuels, 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 UNFCC 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

Tutorial:

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 work:

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

ENVIRONMENTAL MANAGEMENT SYSTEM

CE 76517

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

Course Objectives:

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 stationSanitary 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 act Standards
  12.4.1 Wastewater standard
  12.4.2 Ambient air quality standard

Tutorial:

1. Introduction (1 hour)
   Definitions, examples of pollution and pollutants
2. Environmental health (1 hour)
   Health impacts of pollution, Numerical on risk assessment, LD50method
3. Environment Management (1 hour)
   Definitions, dilution, treatment, prevention, examples on different environment management tools and techniques
4. Wastewater Management (1 hour)
   Definitions, advantages and disadvantages of centralized and decentralized treatment systems, design criteria, pipe materials, examples of WWTPsnumerical on network
5. Air Pollution (1 hour)
   Definitions, reactions of air pollutants, examples of air pollution control technologies
6. Solid Waste Management (1 hour)
   Definitions, management systems, numerical on transportation, examples
7. Cleaner Production (1 hour)
   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.
2. Tchobanoglous, Theisin and Vigil, "Integrated Solid Waste Management – Engineering Principles and Management Issues", McGraw-Hill.
3. R. Drostie, "Theory and Practice of Water and Wastewater Treatment", John Willey & Sons, Inc.
4. ISO, "ISO 14001: Guidance for Use",
5. MOEST, "EPA & Regulations, 2053", Kathmandu

6. SWMTSC, "Solid Waste Management Act, 2011".
7. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Water Supply Engineering", Laxmi Publications (P) Ltd., New Delhi.
8. P.N. Modi, "Water Supply Engineering", Standard Book House, Delhi.
9. G.S. Birdie and J,S, Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
10. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd., New Delhi.

WATER QUALITY MANAGEMENT
CE 76518

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

Course Objectives:

To provide knowledge 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

Tutorial:

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 work:

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

References:

1. Andrew D. Eaton, Lenore S. Clesceri, and Arnold E. Greenberg, "Standard Methods for the Examination of Water and Wastewater",

2. A.K. Deo, "Environmental Chemistry"
3. C. S. Rao, "Environmental Pollution Control Engineering", Wiley eastern ltd.
4. Robert V. Thomann, John A. Mueller, " Principles of Surface Quality Modeling and Control"
5. WHO Guidelines for Drinking-water Quality

POST DISASTER WATER AND SANITATION MANAGEMENT

CE 76519

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

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 diarrhea, 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

Tutorial:

1. Introduction (2 hours)
   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 work:

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. , "Environmental Health in Emergencies and Disaster", WHO
2. Alexander, D. , " Principles of Emergency Planning and Management", Harpended: Terra Publishing.

3. Davis, J., Lambert, R. , "Engineering in Emergencies. A practical Guide for Relief Workers", ITDG Publisher.
4. Del Porto, D., Steinfeld, C., "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. , "At Risk-Natural Hazards, People's Vulnerability and Disaster", Wiltshire Routledge

PUBLIC HEALTH AND RISK ASSESSMENT
CE 76520

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

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 **(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

Tutorial:

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 work:

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

References:

1. Bennett, P., Calman, K. , " Risk Communication and Public Health", Oxford Medical Publications, London.
2. Fjeld, R. A., Eisenberg, N. A., Compton, K. L, "Quantitative Environmental Risk Analysis for Human Health". John Wiley & Sons, NJ.
3. Lawson, A. B., Biggeri, A., Bohning, D., Lesaffre, E., "Disease Mapping and Risk Assessment for Public Health", John Wiley & Sons, England.
4. Robson, M. G., Toscano, W. A, " Risk Assessment for Environmental Health (Public Health/Environmental Health)", Association of Schools of Public Health, John Willey & Sons, San Francisco.
5. Andy Cairncross and Richard G. Feachem, "Environmental Health Engineering in the Tropics",

6. Christopher R. Schulz and Danial A. Okun, "Surface Water Treatment for Communities in Developing Countries",

7. City for Copenhagen, Healthy City Plan, Copenhagen, Copenhagen Health Services, (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, Hemda Garelick 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.

10. RWSSFDB, 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.

INTRODUCTION TO PRESTRESSED CONCRETE ANALYSIS AND DESIGN

CE 76521

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

Course Objectives:

To introduce the fundamental principles of the structural behavior and design criteria of Prestressed Concrete structures with special focuse on Limit State Methods of Design. The Students will learn to use output of structural analysis to design different elements of prestresed Concrete Structures according to Codal Provisions and detailing of Tendons. Finally, the students will be able to analyze and design of prestressed Concrete structures for Gravity Loads and lateral loads. The Course also includes key features of Codal provisions and Detailing of Prestressed Concrete using National and international Buiiding Codes of Prestressed Concrete.

1. Introduction **(3 hours)**

1.1 Historical development
1.2 Basic principles of prestresed Concrete
1.3 Types of Prestressing
1.4 Pretensioning systems
1.5 Post Tensioning systems
1.6 Pretressed Systems and End Anchorages
1.7 Prestressed Concrete Vs reinforced Concreete
1.8 Advantages and disadvantages of prestresed Concrete
1.9 Application of Prestressed Concrete

2. Materials **(3 hours)**

2.1 Composition of Prestressed Concrete
2.2 Characteristics of Concrete
2.3 Characteristics of High Tensile Steel
2.4 Alternative Materials
2.5 Grouting
2.6 High-Strength Concrete and High-Performance Concrete

3. Losses in Prestress **(6 hours)**

3.1 Different types of lossed in Prestressed Concrete
3.2 Estimatin of Losses in Prestress
3.3 Total Amount of Losses
3.4 Deviation of Tendons
3.5 Examples of Losses of Prestress

4. Analysis and Design of Sections for Flexure **(12 hours)**

4.1 Principle of Analysis
4.2 Pretensioned Method of Prestressing
4.3 Post Tensioned methods of Prestressing

4.4 Homogeneous Beam Approach
4.5 Load Balancing Approach
4.6 Stresses in steel due to loads
4.7 Kern Distance and Efficiency of sections
4.8 Tendon Profile
4.9 Pressure Line
4.10 Simplified Code Procedures for design of flesures
4.11 Strength and Serviceability Limit states

5. Analysis and Design of Sections for Shear, Bond and Torsion (12 hours)

5.1 Shear-Geneal Theory
5.2 Shear-Ultimate Limit State-Provision in IS and British Codes
5.3 Examples on shear
5.4 Bond in Prestressed Concrete
5.5 End Zone stresses
5.6 Torsion in Prestressed Concrete
5.7 Design of End Blocks
5.8 Provisions in End block
5.9 Examples on Anchorage and End Zones
5.10 Design of reinforcement for torsion, shear and Bending

6. Analysis and Design of Indeterminate Prestressed Beams and Frames (9 hours)

6.1 Introduction
6.2 Effect of Prestressing in Indeterminate Structures
6.3 Methods of Achieving Continuity of Prestressing
6.4 Methods of analysis
6.5 Concordant Cable Profile
6.6 Design of Continuous Beam with examples
6.7 Design of Portal Frame with examples

Practical: Project and assignment

References:

1. Jain A.K., "Reinforced Concrete Design", Nem /chand & Bros, Roorkee.
2. Rajukrishna N., "Prestressed Concrete",
3. Ramamrutham S, "Prestressed Concrete",
4. Kong F.K. & Evans R.H., "Reinforced and Prestressed Concrete"
5. Relevant Professional codes of Practice for prestresed concrete

ELECTIVE III

GIS APPLICATION AND REMOTE SENSING

CE 78501

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

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 mini-project 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 land use; 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.

Tutorial and Practical:

1. Spatial database development (3 hours)
2. Linking non-spatial and spatial database (3 hours)
3. Projection (3 hours)
4. Database editing and updating (6 hours)
5. GPS data integration in GIS, (2 hours)
6. Geo processing (3 hours)
7. Spatial analysis (4 hours)
8. River analysis (2 hours)
9. Map layout (2 hours)
10. Mini-project for GIS application (8 hours)

References:

1. Raghunath Jha (2000), " Course Manual for GIS", IOE, Water Resources Engineering.
2. P.A. Burrough and R. A. McDonnell, Principles of Geographical Information Systems, Oxford University Press.
3. J. Star and J. Estes , "Geographic Information Systems: An Introduction", Prentice Hall, Englewood Cliffs, N.J.

4. J. Lee, D.W.S. Wong , Statistical Analysis with Arc View GIS", John Wiley and Sons, Inc., New York.
5. Davide J Maguire, Michael Goodchild and David W RHIND, "Geographical Information Systems Vol 1: Principles", Longman Scientific Technical.
6. Laura Lang, "Managing Natural Resources with GIS", ESRI, Redlands, CA.

CONSTRUCTION SAFETY MANAGEMENT

CE 78502

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

Course Objectives:

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 Equipment

4. Site Safety Management **(4 hours)**

4.1 Workplace and Equipment
4.2 Structures and Equipment
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

Tutorial/Practical:

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", All India Traveller Book Seller, Fifth Edition.
2. Vaid, K.N. "Construction Safety Management", NICMAR Publication.

PROCUREMENT MANAGEMENT
CE 78503

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

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

Tutorial:

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.

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

CE 78504

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

Course Objectives:

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

Tutorial:

1. Introduction to EIA (2 hours)
   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

References:

1. Canter, Larry W., "Environmental Impact Assessment", McGraw Hill.
2. Upreti, B. K, " Environmental Impact Assessment: Process and Practice", Uttara Uprety, Koteshwor.
3. IUCN/Nepal, "EIA Training Manual for Professionals and Managers", IUCN/ Nepal.

TIME SERIES ANALYSIS
CE 78505

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

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; Midsquare 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

Tutorial:

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

DISASTER RISK MANAGEMENT

CE 78506

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

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.

1. **Introduction to Disaster Risk Management** **(4 hours)**

2. **Terminology on DRR** **(2 hours)**

3. **Hazard, Risk and Vulnerabilities** **(6 hours)**
   - 3.1 Physical dimensions
   - 3.2 Social dimensions
   - 3.3 Economic dimensions
   - 3.4 Disaster and emergencies - its types and level of impact

4. **Disaster Management Cycle** **(12 hours)**
   - 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

5. **Cluster Approach** **(6 hours)**

6. **Assessment tools** **(6 hours)**

7. **Risk Reduction approach, Strategies and Polices** **(4 hours)**

8. **Risk Analysis Technique** **(5 hours)**

Tutorial and Practical:

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