ENGINEERING MATHEMATICS III
SH 501

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

Course Objective:
The purpose of this course is 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 "≤"
5.5. The Dual: Maximization with Problem Constraints of the form "≥"
5.6. Maximization and Minimization with mixed Constraints. The two-phase method (Analternative to the Big M Method)

References:

1. E. Kreszig, "Advance Engineering Mathematics", Willey, New York.
2. M.M Gutterman and Z.N.Nitecki, "Differential Equation, a First Course", 2nd Edition, saunders, New York.

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	11	20
2	12	20
3	8	15
4	5	10
5	9	15
Total	**45**	**80**

*There may be minor deviation in marks distribution.

APPLIED MECHANICS (DYNAMICS)

CE 501

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

Course Objectives:

The purpose of the course is to provide basic knowledge of engineering mechanics 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 b 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

Tutorials:
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", , 2nd Edition, Tata McGraw Hill Publishing Co. Ltd., 1998
3. Shames, I.H "Engineering Mechanics – Statics and Dynamics"., 3rd Edition, New Delhi, Prentice Hall of India, 1990
4. Egor .P. Popov "Engineering Mechanics of Solids", , 2nd Edition, New Delhi, Prentice Hall of India, 1996

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

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

*There may be minor deviation in marks distribution.

STRENGTH OF MATERIALS

CE 502

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

Course Objectives:

The purpose of the course is to provide the students for basic knowledge in material behavior, stress-strain relations and their analysis. During the course, students will review on mechanics first and obtain knowledge in stress-strain relations, their types. At the end 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 Moher'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 Hook'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 Hook'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)

1.1 Coplanar and pure bending
1.2 Elastic curve
1.3 Angle of rotation
1.4 Radius of curvature, flexural stiffness
1.5 Small deflection theory
1.6 Bending stress
1.7 Flexural formula, differential equation of deflected shape
1.8 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. Torsion test to determine modules of rigidity
3. Column behavior due to buckling
4. Deflection of simple beam

Tutorials:

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", , 2nd Edition, New Delhi, Prentice Hall of India
4. A.Pytel, F.L. Singer 'Strength of Materials", 4th Edition, Harper Collins, India, 1998

Evaluation Scheme:

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

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

*There may be minor deviation in marks distribution.

ENGINEERING GEOLOGY I
CE 503

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

Course Objective:

This course has been designed to provide basic knowledge of geology to the students of civil engineering. It would be helpful for them to understand how to identify the different types of rocks, minerals, geological structures, geological processes and their impacts on engineering structures etc. Furthermore, the course will help students to know about geological setting of Himalaya, geological structures for development of infrastructures.

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, Syenite Shale, 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

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	2	2
2	3	2
3	4	3
4	6	10
5	5	10
6	8	8
7	2	5
Total	**30**	**40**

*There may be minor deviation in marks distribution.

FLUID MECHANICS
CE 505

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

Course Objective:

A proper understanding of fluid mechanics is extremely important in many areas of civil engineering. This course is aimed at teaching students the concept of water resources engineering and their application in the field of civil engineering. Fundamentals of fluid mechanics are taught in this semester to procede 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, retaining structures and 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

Tutorials:

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 (2 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, 2009
2. "Fluid Mechanics for Civil Engineers", Webber, N.B. 1995, Chapman and Hall.
3. "Victor and Street, Elementary fluid mechanics", sixth edition, John Wiley and sons inc. 605, third avenue, New York
4. D.S. Kumar "Fluid Mechanics and Fluid power Engineering", S.K. Kataria and Sons, sixth edition, 2005
5. K. L. Kumar "Engineering Fluid Mechanics", , Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi, 2000.
6. S Ramamrutham "Hydraulics fluid mechanics and fluid machines",. Dhanpat Rai Publishing Company (P) Ltd. New Delhi Seventh Edition 2006
7. D. P. Sangroula "Fundamentals of Fluid Mechanics", , Nepal Printing Support, Anamnagar, Kathmandu, 2008
8. P.K. Bansal "A text book of fluid Mechanics" Laxmi Publishers, 2005

Evaluation Scheme:

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

Chapters	**Hours**	**Marks distribution***
1	3	6
2	4	6
3	10	15
4	4	6
5	2	4
6	7	12
7	6	8
8	3	7
9	3	8
10	3	8
Total	**45**	**80**

*There may be minor deviation in marks distribution.

SURVEYING I
CE 504

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

Objectives:
The objective of this course is to introduce civil engineering students with the basic knowledge of land measurement and surveying techniques. The overall course is designed to make the students able to learn and understand the theory and field procedure by applying suitable surveying methods to produce map.

1. Introduction (2 hours)
- 1.1 History of Surveying
- 1.2 Principle of surveying
- 1.3 Disciplines of surveying and their significance

2. Distance Measurements (5 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 errors and sources of errors in making measurements, precision and accuracy,
- 2.5 Introduction o f scales used in surveying
- 2.6 Various corrections for linear distance measurements

3. Chain Survey (2hours)
- 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 travesing, errors and adjustment.
- 4.5 Traverse plotting

5. Leveling (6 hours)

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 (2 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 (5 hours)

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

9. Computation of Area and Volume (5 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:	**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 no 2	3

References:

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

Evaluation Scheme

There will be questions covering all the chapters in the syllabus. The evaluation schemes for the question will be as indicated in the table below

Chapter	Hours	Marks Distribution*
1	3	4
2	6	12
3	3	4
4	7	16
5	8	16
6	3	4
7	5	10
8	4	6
9	6	8
Total	45	80

* There may be minor deviation in marks distribution

CIVIL ENGINEERING MATERIALS
CE 506

Year : II
Part : I

Lecture : 2
Tutorial : 0
Practical : 1

Course objectives:-

The Course in Civil Engineering Material are intended to introduce the students to a wide range of materials that can be used in construction and maintenance of civil engineering project. Emphasis in the course is placed on the properties and uses of the construction material. This would help in selecting suitable material for each particular project. This would allow adequate consideration and precautions during the design and construction phase.

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 Constitutents 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. Paint and Varnishes **(3 hours)**

9.1 Function, ingredient, Type and Uses of Paint 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
3. Consistency test of cement
4. Setting time test of cement
5. Soundness test of cement
6. Compressive strength of cement

Reference:-

1. Peter A. Thornton and Vito J. Colangela Prentice “Fundamental of Engineering Materials”, Hall Publishing Company, 1985.
2. Parbin Singh “Civil Engineering Material”, , Katson Books,2008.
3. R.K.Rajput “Engineering Material”, , S. Chand & Company Ltd,2004.

Evaluation Scheme

There will be questions covering all the chapters in the syllabus. The evaluation schemes for the question will be as indicated in the table below

Chapters	Hours	Marks distribution*
1	2	3
2	3	4
3	3	4
4	2	3
5	4	5
6	2	3
7	3	4
8	4	5
9	3	4
10	4	5
Total	**30**	**40**

* There may be minor deviation in marks distribution

THEORY OF STRUCTURES I
CE 551

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

Course objectives:

The purpose of this course is to provide concept and knowledge of structural analysis with the emphasis of statically determinate structure. By the end of this course, it is expected that the students will be 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
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 Area Moment 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 Arches
6.2 Three-Hinged Structures with Support at Same and different Level
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

Tutorials: 12 assignments, 2 seminar presentations

References:

1. C.H. Norris, J.B. Wilbur and S.Utku "Elementary structural Analysis", 3rd Edition, New York: McGraw-Hill Book Co., 1977
2. Wong Y. Yang "Applied Numerical Methods using MATLAB", , et.Al., John Willey & Sons, 2005
3. William Weaver, JR., james M. Gere "Matrix Analysis of Frames Structures", , 2nd Edition, CBS Publishers and Distributers, India
4. A. Darkov and Kuznetsov "Structural Mechanics", , Mir Publishers

Evaluation Scheme:

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

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

* There may be minor deviation in marks distribution.

HYDRAULICS
CE 555

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

Course Objective:

The knowledge of hydraulics is essential to the design of various hydraulic structures. This course includes fundamental of hydraulics which aims to impart the concept of water resources engineering and their application in the field of civil engineering.

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 solution (5 hours)

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

3. Three reservoirs problem 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. Ven Te Chow "Open channel hydraulics". McGraw-Hill book company limited, 1973
2. K G Ranga Raju "Flow through open channel",. Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition,1993.
3. D.S. Kumar "Fluid Mechanics and Fluid power Engineering", , S.K. Kataria and Sons, sixth edition, 2005
4. K. L. Kumar "Engineering Fluid Mechanics", Eurasia Publishing house (P) Ltd. Ram Nagar New Delhi, 2000.
5. S Ramamrutham "Hydraulics fluid mechanics and fluid machines",. Dhanpat Rai Publishing Company (P) Ltd. New Delhi Seventh Edition 2006

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

Tutorials:

There shall be related tutorials exercised in class and given as regular homework exercises. Tutorials 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 problem and 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 (1 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 (4hours)
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 programme (studied in I/I) 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

Evaluation Scheme:

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

Chapters	Hours	Marks distribution*
1	9	8
2	5	8
3	6	10
4	5	8
5	2	4
6	7	10
7	10	12
8	8	8
9	4	6
10	4	6
Total	**60**	**80**

*There may be minor variation in marks distribution

SURVEYING II
CE 554

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

Objectives:
The objectives of this course is to introduce fundamental knowledge of land measurement and modern survey application. After completion of this course 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 bearings and adjustment of bearings, computation of latitudes and departures, error of closure and relative precision, balancing of consecutive coordinates, computation of independent coordinates 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:		**Hours**
1.	Traverse survey, computation and plotting	**9**
2.	Application of tacheometry to measure distance and elevation by using stadia system including detailing, computation and plotting	**9**
3.	Intersection and resection using theodolite	**3**
4.	Trigonometric leveling	**3**
5.	Contouring – Indirect leveling	**6**
6.	Setting out of simple circular curve, transition and vertical curve	**6**
7.	Demonstration and application of Total Station	**3**
8.	Demonstration and application of GPS, GIS, Photogrammetry lab visit	**6**

Tutorials:

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

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	7	16
2	5	10
3	4	6
4	4	8
5	4	8
6	8	12
7	5	6
8	3	8
9	5	6
Total	**45**	**80**

*There may be minor variation in marks distribution

SOIL MECHANICS
CE 552

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

Course Objective:

This course is aimed at teaching the students the concepts of soil engineering, including the science and technology of soils and their application to problems in Civil engineering.

The course emphasizes the fundamentals and relevant principles of soil mechanics, gives an overall picture of the behaviour of soils and describes 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 – Lap laces 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 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 Void Ratio – Pressure plots
9.5 Normally consolidated and over consolidated clay
9.6 Effect of Disturbance on Void 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 undrained Triaxial Test
10.8 Unconsolidated undrained Triaxial 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 Ø = 0 Analysis (Total stress Analysis)
11.6 C – Ø 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

Tutorials:

1. Introduction (0.5 hour)
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”, 2nd Edition, New York, 1967
2. Braja M. Das “Principles of Geotechnical Engineering” Fifth edition. Thomson/Brookscole
3. Joseph E Bowles “Physical and Geological properties of soils”, , Mc Graw Hill Co. Ltd 2nd Edition 1984.
4. Gopal Ranjan and ASR Rao “Basic and Applied soil mechanics “, second edition New Age International publishers,2000

5. K. R. Arora “Soil mechanics and foundation Engineering” Standard Publisher Distribution 1997
6. S.R. Kaniraj “Design Aids in Soil Mechanics and Foundation Engineering “, Tata Mc Graw Hill Education Limited, 2010
7. V.N.S. Murthy “A Text Book of Soil Mechanics and Foundation Engineering in SI units“ UBS Publishers Distributors Ltd.Fourth edition 1993
8. Dr. Sehgal “A text book of soil mechanics” S.B. CBS Publishers and distributors, New Delhi, 1988

Evaluation Scheme:

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

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

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

PROBABILITY AND STATISTICS
SH 552

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

Course Objective:

To provide the students with particle knowledge of the principales 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. Correlation and Regression (6 hours)

5.1. Least square method
5.2. An analysis of variance of Linear Regression model
5.3. Inference concerning Least square method
5.4. Multiple correlation and regression

6. Inference Concerning Mean (6 hours)

6.1. Point estimation and interval estimation
6.2. Test of Hypothesis
6.3. Hypothesis test concerning One mean
6.4. Hypothesis test concerning two mean
6.5. One way ANOVA

7. Inference concerning Proportion (6 hours)

7.1. Estimation of Proportions
7.2. Hypothesis concerning one proportion
7.3. Hypothesis concerning two proportion
7.4. Chi square test of Independence

9. 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 7th edition", Miller and Freund's publication
2. Jay L. Devore, " Probability and Statistics for Engineering and the Sciences" , Brooks/Cole publishing Company, Monterey, California,1982
3. Richard I. Levin, David S Rubin, " Statistics For Management", Prentice Hall publication
4. Mendenhall Beaver Beaver, " Introduction Probability and statistics 12th edition ", Thomson Brooks/Cole

Evaluation scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

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

*There may be minor deviation in marks distribution.

BUILDING DRAWING
AR 556

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

Course Objective:

Objective of building drawing and drafting course is to introduce students the basic terminology, component and element of building drawing. This course is designed to familiarize the students with the fundamentals of building drawing and drafting skill. Emphasis is placed on drafting floor plan, elevation, section and details 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	Hour
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. "Metrix Architectural construction drafting and design fundamentals", Willian J. Hornung.
4. John Molnar "Building construction drafting and design"
5. Brian W. Boughton."Building and Civil engineering construction"
6. Hornung "Architectural Drafting, 5th edition"
7. John D. Bies. "Architectural drafting: Structure and Environment"
8. Thomas, Marvin L."Architectural Working Drawing"

Evaluation scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution *
1 & 2	2	4
3	5	10
4	7	14
5	1	2
Total	**15**	**30**

*There may be minor deviation in marks distribution.

ENGINEERING GEOLOGY II
CE 553

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

Course Objective:

This course has been designed to provide knowledge of Engineering Geology to the students of civil engineering. It would be helpful for them to understand, how to measure the geological data from field, to analyze and interpret them for 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. Rock mass: 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, John Wiley and Sons Inc. “Principles of Engineering Geology”
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, Meghraj Dhital, 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. Bishal Nath Upreti and Dr. Meghraj Dhita “Landslide Studies and Management in Nepa”: l, ICIMOD

Evaluation scheme:

The questions will cover the entire chapter of the syllabus. The evaluation scheme will be as indicated in the table below:

Chapters	Hours	Mark distribution *
1	3	3
2	3	3
3	2	2
4	5	9
5	6	10
6	8	10
7	3	3
Total	**30**	**40**

*There may be minor deviation in marks distribution.