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