B.E. DEGREE
IN
CIVIL ENGINEERING

Year : III | Part : I

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

NUMERICAL METHODS
SH 603

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

Course objective:

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

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

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

2. Solutions of Nonlinear Equations (5 hours)

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

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

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

4. Interpolation (8 hours)

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

5. Numerical Differentiation and Integration (6 hours)

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

6. Solution of ordinary differential equations (6 hours)

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

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

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

Practical:

Algorithm and program development in C programming language of following:

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

References:

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

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

THEORY OF STRUCTURES II

CE 601

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

Course Objectives:

The threefold objective of the course is to:

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

1. Introduction (8 hours)

1.1 Formulation of problems in theory of structure: functions of the structural systems and the corresponding requirements/conditions to be fulfilled, strength, stiffness and stability of a system

1.2 Conditions and equations: static, compatibility, and physical

1.3 Satisfaction of conditions

1.4 Boundary conditions, partial restraints

1.5 Solutions of equations

1.6 Structure idealization, local and global coordinate systems and static and deformation conventions of signs

1.7 Indeterminacy of structural systems its physical meanings and its types

1.8 Degree of static indeterminacy of a system and its determination/ calculation: static indeterminacies; use of formula, necessity of visual checking: for plane systems only in the form of truss, frame and arch

1.9 Degree of kinematic indeterminacy of a system and its determination/ calculation: use of formula, necessity of visual checking: for plane systems only in the form of truss, frame and arch

1.10 Definitions and explanations of force and displacement for a structural system as operational parameters in comparison with systemic parameters like dimensions of system and elements and their material properties

1.11 Force and displacements as cause and effects; Betti's law and Maxwell's reciprocal theorem, their uses and the limitations

1.12 Two theorems from Castigliano and their applications: use of second theorem for determination of displacements in statically determinate and solution of statically indeterminate simple systems like beam and truss

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

2. Force Method (12 hours)

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

3. Displacement Method (15 hours)

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

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

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

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

5. Introduction to Plastic Analysis (6 hours)

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

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

Practical: **(8 hours)**

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

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

References:

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

FOUNDATION ENGINEERING

CE 602

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

Course Objectives:

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

1. Introduction **(1 hour)**

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

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

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

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

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

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

3.8 Proportioning of Retaining Walls
3.9 Stability of Retaining Walls

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

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

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

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

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

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

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

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

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

8.1 Introduction

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

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

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

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

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

Tutorial:

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

1. Introduction **(0.5 hours)**

Theory; definition and concept type questions

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

Theory; definition, numerical examples types of questions

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

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

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

Definition type; Practical example type and numerical type questions

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

Definition type; Practical example type and numerical type questions

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

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

7. Mat Foundations (1 hour)

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

8. Pile Foundations (2 hours)

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

9. Well Foundations (1 hour)

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

10. Foundations Soil Improvements (1 hour)

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

Practical:

Field tests on penetration test.

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

References

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

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

SURVEY CAMP
CE 604

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

Objectives:

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

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

A) Horizontal Control Practices for Large Area Major Traverse:

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

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

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

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

Time Allocated: 5 Days

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

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

C) **Bridge Site Survey:**

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

Time Allocated: 1.5 Days

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

D) **Road Alignment Survey:**

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

Time Allocated: 1.5 Days

Requirements:

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

Evaluation Criteria:

For Internal 50 Marks:

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

For Final 50 Marks:

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

WATER SUPPLY ENGINEERING
CE 605

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

Course Objectives:

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

1. Introduction **(2 hours)**

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

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

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

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

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

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

3.4 Variation in demand of water

3.5 Peak factor

3.6 Factors affecting demand of water

3.7 Population forecasting - necessity and methods
- 3.7.1 Arithmetical increase method
- 3.7.2 Geometrical increase method
- 3.7.3 Incremental increase method
- 3.7.4 Decrease rate of growth method
- 3.7.5 Numerical on population forecasting and water demands

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

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

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

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

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

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

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

5. Intakes **(3 hours)**

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

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

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

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

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

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

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

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

7.2 Clear water reservoirs

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

7.4 Numerical on capacity determination of service reservoirs

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

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

7.7 Numerical on design of branched and looped water distribution systems

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

- 8.1 Pipe materials
  - 8.1.1 Requirements of good material
  - 8.1.2 Types of pipe material – CI, GI, steel, concrete, PVC, PPR, DI pipes
- 8.2 Pipe joints
  - 8.2.1 Purpose
  - 8.2.2 Types – socket and spigot, flanged, expansion, collar and screwed socket joints
- 8.3 Laying of pipes

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

- 9.1 Valves
  - 9.1.1 Purpose
  - 9.1.2 Types – sluice, reflux, safety, air and drain valves
- 9.2 Fittings
  - 9.2.2.1 Purpose
  - 9.2.2.2 Types – stop cocks, water taps, bends, reducers, tees
- 9.3 Break pressure tank – purpose and construction
- 9.4 Public stand post
  - 9.4.1 Purpose
  - 9.4.2 Location
  - 9.4.3 flows
  - 9.4.4 Construction
- 9.5 Maintenance of water supply system
  - 9.5.1 Necessity
  - 9.5.2 Methods-regular and emergency

Practical:

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

Tutorial:

1. Introduction (1 hour)

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

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

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

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

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

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

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

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

5. **Intakes** **(1 hour)**

   Definitions, Typical figures of River, Reservoir and Spring intakes

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

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

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

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

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

   Definitions, Typical figures of pipe joints

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

   Definitions, Typical figures of valves

References:

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

CONCRETE TECHNOLOGY AND MASONRY STRUCTURE
CE 603

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

Course Objectives:

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

Part I: Concrete Technology

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

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

2. Structure of Concrete (3 hours)

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

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

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

4. Properties of Hardened Concrete (3hours)

- 4.1 Deformation of hardened concrete, Moduli of elasticity

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

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

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

6. Concrete Durability **(3hours)**

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

Part II Masonry Structures

7. Introduction to Masonry Structures **(4hours)**

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

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

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

9. Masonry Structures under Lateral Loads **(5hours)**

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

10. Testing of Masonry Elements **(3hours)**

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

Practical:

Part I: Concrete Technology

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

Part II: Masonry Structures

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

References:

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

CE 606

Lecture : 3
Tutorial : 1
Practical : 2/2

Year : III
Part : I

Course Objectives:

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

1. Introduction **(2 hours)**

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

2. Precipitation **(8 hours)**

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

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

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

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

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

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

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

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

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

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

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

Tutorial:

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

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

Practical:

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

References:

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