B.E.

Institute of Engineering

Civil III Year I Part

NUMERICAL METHODS
SH 553

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

Course objective:
The course aims 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 agrange interpolation
4.4 Least square method of fitting linear and nonlinear curve for discrete data and continuous function
4.4 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
8.6 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 1^{st} 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, 7^{th} edition.
2. Robert J schilling, Sandra l harries , " Applied Numerical Methods for Engineers using MATLAB and C.", 3^{rd} edition Thomson Brooks/cole.
3. Richard L. Burden, J.Douglas Faires, "Numerical Analysis 7^{th} edition" , Thomson / Brooks/cole

4. John. H. Mathews, Kurtis Fink ," Numerical Methods Using MATLAB 3rd edition " ,Prentice Hall publication
5. JAAN KIUSALAAS , " Numerical Methods in Engineering with MATLAB" , Cambridge Publication

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	16
2		
3	8	16
4	8	16
5	6	10
6	6	10
7	8	12
Total	**45**	**80**

* There could be a minor deviation in the marks distribution

THEORY OF STRUCTURES II

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

Course Objective:
The threefold objective of the course is to:

1. Familiarize the terminologies and concepts of displacements, stresses, strains, stiffness etc. and their parameters in the context of indeterminate systems,
2. 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,
3. 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)

Experiments (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., 1979, *Structural Mechanics*, Mir Publishers, Moscow.

2 Ghali A, Neville A M, 1989, *Structural Analysis, A Unified Classical and Matrix Approach,* Chapman and Hall.

3 Joshi H R, 1991, *Theory of Structure II - Course Manual*, Institute of Engineering, Tribhuvan University, Katmandu.

4 Norris C H, Wilbur J B, Utku S, 1991, *Elementary Structural Analysis,* McGraw-Hill International Editions, Civil Engineering Series.

5 Pandit G S, Gupta S P, 1981, *Structural Analysis, A Matrix Approach*, Tata McGraw-Hill Publishing Company Limited, New Delhi.

6 Reddy C S, 1981, *Basic Structural Analysis,* Tata McGraw-Hill Publishing Company Limited, New Delhi.

7 Wang C K, 1983, *Intermediate Structural Analysis,* McGraw-Hill International Editions, Civil Engineering Series.

Evaluation Scheme

The questions will cover all the chapters of the syllabus as far as practicable. The approximate mark allocation to the questions is proposed to be as indicated in the table below:

Chapters	Hours	Mark distribution*
1	**8**	**15**
2	**12**	**25**
3	**15**	**25**
4	**4**	**5**
5	**6**	**10**
Total	**45**	**80**

* There may be minor variation in marks distribution

FOUNDATION ENGINEERING

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

Course Objective:
The objective of this course is to provide the student with the basic concepts and tools that can be used to determine the structure/ foundation/ soil interactions. The courses include a review of soil mechanics principles and deal with a variety of foundations and retaining walls.

1. Introduction [1 hour]
- 1.1. Foundation Engineering, Importance and purpose
- 1.2. Classification and general requirement
- 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 programme
- 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 Terzaghis 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 stabilisation by use of admixtures
10.7. Soil stabilisation by injection of suitable grouts

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. Introduction (0.5 hour)
Theory; definition and concept type questions.

2. Soil Exploration (2.0 hours)
Theory; definition, numerical examples types of questions.

3. Lateral Earth Pressure Theories and Retaining Walls (3.0 hours)
Concept type; practical examples and numerical type questions.
There can be tutorials for each sub-section

4. Arching in Soils and Braced Cuts (1.0 hours)
Definition type; Practical example type and numerical type questions

5. Flexible Retaining Structures and Coffer Dams (1.0 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 (1.0 hour)
Concept type; definition type; Practical example type questions.
There can be tutorials for each sub-section.

8. Pile Foundations (2.0 hour)
Definition type; numerical examples type questions. Practical example type questions.
There can be tutorials for each sub-section.

9. Well Foundations (1.0 hours)
Concept type; definition type; numerical examples and Practical type questions.
There can be tutorials for each sub-section.

10. Foundations Soil Improvements (1.0 hours)
Concept type; definition type and Practical type questions.
There can be tutorials for each sub-section.

Laboratories
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. "Foundation Analysis and Design" Joseph E.Bowels. McGraw-Hill International Editions, Fifth Edition, 1997
2. "Principles of Foundation Engineering" Braja M. Das, Fifth Edition, 2003. Thomson/Brookscole
3. "Basic and Applied soil mechanics "Gopal Ranjan and ASR Rao, Second

Edition New Age International publishers,2000
4. “Soil mechanics and Foundation Engineering” K. R. Arora Standard Publisher Distribution 1997
5. “A Text Book of Soil Mechanics and Foundation Engineering in SI units “V.N.S. Murthy UBS Publishers Distributors Ltd.Fourth Edition 1993.
6. ”A Text Book of Foundation Engineering”, Dr. R.K.Poudel and R.Neupane, 1st Edition, 2006.
7. “Pile Foundation Analysis and Design” H.G.Poulos and E.H.Davis, John Wiley and Sons, 1980

Evaluation Scheme:

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

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

* There may be minor deviation in marks distribution.

SURVEY CAMP

Lecture : As per the requirements on the campsite **Year : III**

Tutorial : 0 **Part : I**

Practical : 10 days (10*13hrs) Field Works

Objective:
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 5 (five). For conducting camp as far as possible modern surveying equipments 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 contentwise and all the reference sketches and standard drawings shall be compiled in A**3** size and all the original data and drawings shall be presented during final viva.

WATER SUPPLY ENGINEERING

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

Course Objective:
This course is aimed at teaching the students 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. Fire fighting 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
   - 3.8. 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. Ionizaton 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
9.2.1. Purpose
9.2.2. Types – stop cocks, water taps, bends, reducers, tees
9.3. Break pressure tank – purpose and construction
9.4. Public standpost
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

References:

1 BC. Punmia, Ashok Kuamr Jain and Arun Kumar Jain, "Water Supply Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
2 P.N. Modi, "Water Supply engineering", Standard Book House, Delhi, 1998
3 G.S. Birdie and J.S. Birdie, "Water Supply and Sanitary Engineering", Dhanpat Rai Publishing Company (P) Ltd,. New Delhi, 2002
4 K.N. Duggal, "Elements of Environmental Engineering"' S. Chand and company Ltd.., New Delhi, 1997

Practical:

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

Tutorials:

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

Evaluation Scheme:

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

Chapters	Lecture Hours	Tutorial Hours	Marks Distribution*
1	2	1	4
2	4	1	4
3	5	2	8
4	5	2	8
5	3	1	8
6	14	3	24
7	6	3	16
8	3	1	4
9	3	1	4
Total	45	15	80

* There may be minor variation in marks distribution

Concrete Technology and Masonry Structures

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

Course Rationale:
The course provides practical information on concrete technology and masonry structures. The first part of the course deals with concrete technology and in this part students will learn properties of concrete ingredients and will be able to design concrete mix of different grades using commonly used methodologies. The students will also learn properties of green and hardened concrete and will learn the tools and techniques of quality control in different stages of use of concrete. The second part deals with Masonry structures and in this part students will learn classification, construction technologies and behavior of masonry structures. The students will be able to 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 structure 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 [6 hours]
- 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 [3 hours]
- 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 [6 hours]
- 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 [3 hours]
- 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 [4 hours]
- 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 [8 hours]
- 8.1. Introduction to codal provisions
- 8.2. Design example for gravity loads
  Solid wall, wall with openings, walls with eccentric loadings and walls acting as columns

9. Masonry structures under lateral loads [5 hours]

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 [3 hours]

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

Laboratories

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, 2005
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, 1987
5. A.W. handry, B.P. Sinha, S.R. Davies, An Introduction to Load Bearing Brick Design, University of Edinburgh, 1981
6. P. Dayaratnam, Brick and Reifnorced Brick Structures, Oxford and IBH Publishing Co. Pvt. Ltd. 1987
7. IS 456, 2000
8. IS 383, 1970
9. IS 1905/ SP 20
10. Nepal National Building Code (NBC) 109, 1994

Evaluation scheme

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

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

* There may be minor variation in marks distribution

ENGINEERING HYDROLOGY
CE ….

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

Course Objectives:
This course is aimed at teaching students the concept of hydrology and computational analysis for the design and management of water resources projects. It gives a practical approach to the various facets of the subject and emphasizes the application of hydrological knowledges to solve engineering problems.

1. Introduction [2 hours]
- 1.1. Definition and Uses of Engineering hydrology
- 1.2. Hydrologic cycle and water balance equations
- 1.3. Development of hydro-meteorological study in Nepal

2. Precipitation [8 hours]
- 2.1. Causes, forms and types of precipitation
- 2.2. Measurement of rainfall (types and adequacy of rain gauges)
- 2.3. Snow fall and its measurements
- 2.4. Estimation of missing rainfall data
- 2.5. Test for inconsistencies of rainfall data (Double Mass Curve)
- 2.6. Presentation of rainfall data (Mass curve, Hyetograph, Average curve of annual rainfall)
- 2.7. Estimation of mean rainfall over an area
- 2.8. Development of Intensity - Duration - Frequency (IDF) curve and equation
- 2.9. Depth - Area - Duration (DAD) curve

3. Hydrological Losses [8 hours]
- 3.1. Initial losses (Interception and depression storage)
- 3.2. Evaporation process
  - 3.2.1. Meteorological parameters (Radiation, Temperature, Vapor pressure, Humidity, Wind)
  - 3.2.2. Energy Budget methods and Mass transfer approach (Dalton's law)
  - 3.2.3. Evaporimeters
- 3.3. Evapotranspiration
  - 3.3.1. Actual evapotranspiration and Lysimeters
  - 3.3.2. Potential Evapotranspiration (Penman's equation)
- 3.4. Infiltration
  - 3.4.1. Horton's equation
  - 3.4.2. Infiltration indices (Φ and W)
  - 3.4.3. Infiltrometers

4. Surface Runoff [8 hours]
- 4.1. Drainage basins and its quantitative characteristics
- 4.2. Factors affecting runoff from a catchment
- 4.3. Rainfall - Runoff relationship
- 4.4. Stream gauging (selection of sites, types of gauges and measurement)
- 4.5. Stream flow measurement by velocity area method (current meters, floats and velocity rods)
- 4.6. Stream flow computation by slope area method
- 4.7. Development of Rating curve and its uses
- 4.8. Estimation of monthly flows from rainfall

5. Hydrograph Analysis [7 hours]
- 5.1. Components of a hydrograph
- 5.2. Separation of base flow
- 5.3. Unit hydrographs, their uses and limitations
- 5.4. Derivation of unit hydrographs from isolated and complex storms
- 5.5. Derivation of unit hydrographs of different durations

6. Flood Hydrology [7 hours]
- 6.1. Design flood and its frequency
- 6.2. Statistical methods of flood prediction
  - 6.2.1. Continuous Probability distribution
  - 6.2.2. Return period, Frequency and risk
  - 6.2.3. Plotting positions, frequency factors
  - 6.2.4. Log Pearson III Method
  - 6.2.5. Gumbel's Extreme Value Type I Method
- 6.3. Flood prediction by Rational and Empirical methods

7. Flow Routing [5 hours]
- 7.1. Linear Reservoir routing
- 7.2. Time area Method
- 7.3. Clark Unit hydrograph

Tutorials:

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:

- Rainfall – Runoff Simulation
- Field visit at meteorological station
- Stream flow measurement by velocity area method (Current meter and Floats)
- Stream flow measurement by dilution techniques.

Recommended Books and 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

Evaluation Scheme:

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

Chapter	Hours	Marks Distribution*
1	2	4
2	8	12
3	8	14
4	8	14
5	7	14
6	7	14
7	5	8

* There may be minor variation in marks distribution

B.E.

Institute of Engineering

Civil III Year II Part

COMMUNICATION ENGLISH
SH….

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

Course Description

'Technical communication in English' is a compulsory course designed to equip the learners with the communication skills required for their professional competence in English. The course is divided into three sections. The first unit deals with reading skill under which there are three sub-divisions consisting of intensive reading, extensive reading of selected authentic texts and contextual grammar respectively. The second unit is concerned with wide- ranging varieties of relevant professional writings (i.e. Proposal, report and project work). The third section consists of Language lab in which different language activities related to listening and speaking skills are incorporated.

Course Objectives

The **general objectives** of the course:

- To enable the learners to develop their reading skills.
- To enforce them to review the knowledge and skills of grammar in English.
- To enable the students to produce different varieties of professional writings based on the changing needs of the learners.
- To develop listening skill in English acquainting the learners with native pronunciation.
- To enhance the speaking skill of the learners.
- To enable the students to present technical talks.

The specific objectives of the course:

- To make them able to read any authentic texts in English related to their field.
- To enable them to interpret the passages.
- To enable them to use the terms/vocabulary found in the reading text.
- To help them apply the grammatical usage to their practical communication.
- To enable the students to write notices, agenda and minutes.
- To make the students capable of producing professional writings such as research articles, technical proposals, reports and project work.
- To familiarize the students with the native speakers' pronunciation with the use of audio-visual aids.
- To enable them to speak English with proper accent and accuracy.

Unit I: Reading (15 periods)

1. **Intensive Reading** 8 periods
   - 1.1. Comprehension
   - 1.2. Note-taking
   - 1.3. Summary writing
   - 1.4. Contextual questions based on facts and imagination
   - 1.5. Interpreting text

2. **Extensive Reading** **5 periods**
   - 2.1. Title/Topic Speculation
   - 2.2. Finding theme
   - 2.3. Sketching character

3. **Contextual Grammar** **2 periods**
   - 3.1. Sequence of tense
   - 3.2. Voice
   - 3.3. Subject-Verb agreement
   - 3.4. Conditional Sentences
   - 3.5. Preposition

Unit II: Writing **(30 periods)**

1. **Introduction to technical writing process** **2 periods**
   - 1.1. Composing and editing strategies
   - 1.2. MLA and APA comparison

2. **Writing notices with agenda and minutes** **2 periods**
   - 2.1. Introduction
   - 2.2. Purpose
   - 2.3. Process

3. Writing Proposal **6 periods**

3.1. Introduction

3.2. Parts of the proposal

- 3.2.1. Title page
- 3.2.2. Abstract/Summary
- 3.2.3. Statement of Problem
- 3.2.4. Rationale
- 3.2.5. Objectives
- 3.2.6. Procedure/Methodology
- 3.2.7. Cost estimate or Budget
- 3.2.8. Time management/Schedule
- 3.2.9. Summary
- 3.2.10. Conclusion
- 3.2.11. Evaluation or follow-up
- 3.2.12. Works cited

4. Reports

4.1. Informal Reports 6 periods

- 4.1.1. Memo Report
  - 4.1.1.1. Introduction
  - 4.1.1.2. Parts
- 4.1.2. Letter Report
  - 4.1.2.1. Introduction
  - 4.1.2.2. Parts

4.2. Project/Field Report 3 periods

- 4.2.1. Introduction
- 4.2.2. Parts

4.3. Formal report 9 periods

- 4.3.1. Introduction
- 4.3.2. Types of Formal Reports
  - 4.3.2.1. Progress Report
  - 4.3.2.2. Feasibility Report
  - 4.3.2.3. Empirical/ Research Report
  - 4.3.2.4. Technical Report
- 4.3.3. Parts and Components of Formal Report
  - 4.3.3.1. Preliminary section
    - 4.3.3.1.1. Cover page
    - 4.3.3.1.2. Letter of transmittal/Preface
    - 4.3.3.1.3. Title page
    - 4.3.3.1.4. Acknowledgements
    - 4.3.3.1.5. Table of Contents
    - 4.3.3.1.6. List of figures and tables
    - 4.3.3.1.7. Abstract/Executive summary
  - 4.3.3.2. Main Section
    - 4.3.3.2.1. Introduction
    - 4.3.3.2.2. Discussion/Body
    - 4.3.3.2.3. Summary/Conclusion
    - 4.3.3.2.4. Recommendations
  - 4.3.3.3. 4.3.3.3 Documentation
    - 4.3.3.3.1. Notes (Contextual/foot notes)
    - 4.3.3.3.2. Bibliography
    - 4.3.3.3.3. Appendix

5. **Writing Research Articles** 2 periods

5.1. Introduction

5.2. Procedures

References

1. Konar, Nira (2010), Communication Skills for Professional PHI Learning Private Limited, New Delhi.
2. Kumar, Ranjit (2006), Research Methodology, Pearson Education.
3. Laxminarayan, K.R (2001), English for Technical Communication. Chennai; Scitech publications (India) Pvt. Ltd.
4. Mishra, Sunita et. al. (2004), Communication Skills for Engineers, Pearson Education First Indian print.
5. Prasad, P. et. al (2007), The functional Aspects of Communication Skills S.K. Kataria & sons.
6. Rutherfoord, Andrea J. Ph.D (2001), Basic Communication Skills for Technology, Pearson Education Asia.
7. Rizvi, M. Ashraf (2008), Effective Technical Communication. Tata Mc Graw Hill.
8. Reinking A James et. al (1999), Strategies for Successful Writing: A rhetoric, research guide, reader and handbook, Prentice Hall Upper Saddle River, New Jersey.

9. Sharma R.C. et al. (2009), Business Correspondence and Report Writing: A Practical Approach to Business and Technical communication. Tata Mc Graw Hill.
10. Sharma, Sangeeta et. al (2010) Communication skills for Engineers and Scientists, PHI Learning Private Limited, New Delhi.
11. Taylor, Shirley et. al. (2009), Model Business letters, E-mails & other Business documents, Pearson Education.

Language lab		30 hours
Listening		12periods
Activity I	General instruction on effective listening, factors influencing listening, and note-taking to ensure ttention. (Equipment Required: Laptop, multimedia, laser pointer, overhead projector, power point, DVD, video set, screen)	2 periods
Activity II :	Listening to recorded authentic instruction followed by exercises. (Equipment Required: Cassette player or laptop)	2 periods
Activity III	Listening to recorded authentic description followed by exercises. (Equipment Required: Cassette player or laptop)	4 periods
Activity IV	Listening to recorded authentic conversation followed by exercises (Equipment Required: Cassette player or laptop)	4 periods
Speaking		18 periods
Activity I	General instruction on effective speaking ensuring audience's attention, comprehension and efficient use of Audio-visual aids. (Equipment Required: Laptop, multimedia, laser pointer, DVD, video, overhead projector, power point, screen)	2 periods
Activity II	Making students express their individual views on the assigned topics (Equipment Required: Microphone, movie camera)	2 periods
Activity III	Getting students to participate in group discussion on the assigned topics	4 periods
Activity IV	Making students deliver talk either individually or in group on the assigned topics (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	8 periods
Activity V	Getting students to present their brief oral reports individually on the topics of their choice. (Equipment Required: Overhead projector, microphone, power point, laser pointer multimedia, video camera, screen)	2 periods

Evaluation Scheme:

Unit	Testing Items	Number of Questions	Marks Distribution
I	Reading Passages	3	15
	Novel	1	5
	Novel	1	5
	Grammar	10 or 5	5
II	Composing & Editing strategies	1	5
	MLA and APA Comparison	1	4
	Writing Research Articles	1	10
	Writing notice, Agenda and minutes	1	5
	Writing Proposal	1	8
	I Writing Reports (Formal Report)	1	10
	II Writing short reports or Project Report	1	8
		Total	80

Language Lab

Title	Testing Items	Number of Questions	Marks Distribution
Language Lab	**Listening** - Instruction - Description - Conversation	3	10
	Speaking - Expressing Individual views - Group/Round Table discussion - Talk delivery - Presenting brief oral report	3	15

DESIGN OF STEEL AND TIMBER STRUCTURES

Lecture : 4 hrs **Year : III**
Tutorial : 2 hrs **Part : II**

Course Objective:

- Make students capable to design ordinary steel and timber structures.
- Prepare students for advanced knowledge on design of complex steel and timber structures.

1. Steel Structures and their Analysis and Design [4 hours]

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

2. Working Stress Design Method [2 hours]

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

3. Limit State Design Method [3 hours]

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

4. Connections in Steel Structures [10 hours]

4.1. Types of Connections
4.2. Welded Connections
  4.2.1. Welds and welding
  4.2.2. Design of simple welded connections
  4.2.3. Design of eccentric welded connections
4.3. Bolted Connections
  4.3.1. Bolts and bolting
  4.3.2. Design of simple bolted connections
  4.3.3. Design of eccentric bolted connections
4.4. Introduction to Riveted Connection

5. Tension Members [4 hours]

5.1. Types of Tension Members
5.2. Sectional Area of Tension Member
5.3. Design of Tension Members of Simple and Built-Up Section
5.4. Design of Lug Angle
5.5. Tension Splice

6. Compression Members [10 hours]

6.1. Types of Compression Member
6.2. Buckling Behavior of Column
6.3. Design of Column of Simple and Built-Up Section
6.4. Design of Lateral Bracing of Compression Member
6.5. Design of Eccentrically Loaded Column
6.6. Design of Column Bases
  6.6.1. Axially loaded column bases
  6.6.2. Eccentrically loaded column bases
6.7. Design of Column Splices

7. Flexure Members [13 hours]

7.1. Types of Beams
7.2. Design of Simple Beam
7.3. Design of Built-Up Beam
7.4. Design of Plate Girder
  7.4.1. Element of plate girders
  7.4.2. Preliminary design
  7.4.3. Design for bending, shear, deflection and lateral stability

7.4.4. Curtailment of plate

7.4.5. Design of web and flange splice

8. Design of Roof Trusses [4 hours]

8.1. Types of Roof Truss and Components of Roof Truss

8.2. Loads on Roof Truss

8.3. Design of Roof Components

PART B: TIMBER STRUCTURES

9. Timber Structures and Design Methods [2 hours]

9.1. Introduction to Timber Structures

9.2. Structural Timber and Factors Affecting the Strength of Timber

9.3. Design Methods and Basis for Design

10. Joints in Timber Structures [2 hours]

10.1. Types of Joints

10.2. Design of Bolted Joints

10.3. Design of Nailed Joints

11. Design of Compression Members [3 hours]

11.1. Types of Timber Columns

11.2. Design of Timber Column

11.3. Introduction to Column Bases

12. Design of Flexure Member [3 hours]

12.1. Types of Beams

12.2. Design of Timber and Flitched Beam

Course Project:

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

Reference books:

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

Evaluation scheme

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

Chapter	Hours	Marks Distribution*
1	4	4
2	2	4
3	3	4
4	10	12
5	4	6
6	10	12
7	13	14
8	4	6
9	2	4
10	2	4
11	3	6
12	3	4
Total	60	80

* There may be minor variation in marks distribution

Building Technology

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

Course Objective:

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

1. Functional Requirements of Buildings (7 hours)

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

2. Foundations (5 hours)

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

3. Mortars & Masonry works (4 hours)

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

4. Roofs (4 hours)

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

5. Stair, lifts and escalators (3 hours)

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

6. Doors and windows (2 hours)

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

7. Flooring (3 hours)

7.1. Flooring and its types
7.2. Special types of floor finishing
7.3. Floor and wall ties

8. Temporary construction (4 hours)

8.1. Scaffolding and its types
8.2. Formwork for excavations & trenches and Formworks for RCC construction
8.3. Shoring and its types
8.4. Underpinning and its procedures

9. Finishing works (4 hours)

9.1. Cladding (types, fixing process)
9.2. Partitions & Suspended ceilings
9.3. Plastering & Pointing (types and process of application)
9.4. Painting works in wooden, metal and masonry surfaces

10. Causes and prevention of cracks in buildings (2 hours)

10.1. Cracks in different components of buildings (walls, roofs, floors, plasters, windows, RCC, joints etc.)

10.2. Causes of cracks and Remedial measures to cracks

11. Earthquake protection & Retrofitting in building (3 hours)

11.1. Earthquake Protection of Buildings

11.2. Techniques of Retrofitting and Retrofitting materials

11.3. Destructive and non-destructive tests in buildings

12. Other services in building (4 hours)

12.1. Water supply & sanitation

12.2. Electrification, CCTV and Telephone network

12.3. Fire Protection

12.4. Rainwater harvesting

Assignments: [10 marks]

1. Drawings of site plan, foundation trench plan, section and timbering of foundation trench.
2. Detailed drawings of foundation structures. Bonding details of junction of walls.
3. Detailed drawings of important building components (foundation, plinth, and superstructure).
4. Detailing of frames and shutters of doors and windows;
5. Drawing plan and section of dog legged stair case.
6. Isometric view, plan and sections of scaffolding, shoring and underpinning.
7. Septic tank, soak pit and isometric view of pipe layout.
8. Layout drawing of power, light circuit and other networks.

Tutorial: 1 hour/week

In tutorial class students will be taught to design a residential/office building and prepare complete working drawings with essential details.

Note:

Student will be allowed to prepare a building plan to work out detailed drawings for tutorial exercises.

References:

1. WB Mckay, ELBS Publication "Building Construction"
2. Goyal, M. M.,"Handbook of Building Construction: The essential source of standard construction practices", 2004, Thomson Press,
3. Chudey & Greeno, Butterworth & Heinemann, "Building Construction Handbook", 1998
4. Reid E.,"Understanding Buildings", , MIT press
5. Pahari, B., "Passive Building: Concept & Design", 2002, ISBN: 99933-34-24-3
6. Building code(NS, IS)
7. S.C.Rangawala, "Building Construction"
8. Ching, FDK, "Building construction Illustrated"

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	7	16
2	5	8
3-4	8	16
5-6	5	8
7-8	7	12
9-10	6	8
11-12	7	12
Total	45	80

* There may be minor variation in marks distribution

Engineering Economics

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

Course Objective:
After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

1. Introduction [3 hours]
- 1.1. Origin of Engineering Economy
- 1.2. Principles of Engineering Economy
- 1.3. Role of Engineers in Decision Making
- 1.4. Cash Flow Diagram.

2. Interest and Time Value of Money [6 hours]
- 2.1. Introduction to Time Value of Money
- 2.2. Simple Interest
- 2.3. Compound Interest
  - 2.3.1. Nominal Interest rate
  - 2.3.2. Effective Interest rate
  - 2.3.3. Continuous Compounding
- 2.4. Economic Equivalence
- 2.5. Development of Interest Formulas
  - 2.5.1. The Five Types of Cash flows
  - 2.5.2. Single Cash flow Formulas
  - 2.5.3. Uneven Payment Series
  - 2.5.4. Equal Payment Series
  - 2.5.5. Linear Gradient Series.
  - 2.5.6. Geometric Gradient Series.

3. Basic Methodologies of Engineering Economic Analysis [8 hours]
- 3.1. Determining Minimum Attractive (Acceptable) Rate of Return (MARR).
- 3.2. Payback Period Method
- 3.3. Equivalent Worth Methods
  - 3.3.1. Present Worth Method
  - 3.3.2. Future Worth Method.
  - 3.3.3. Annual Worth Method.
- 3.4. Rate of Return Methods
  - 3.4.1. Internal Rate of Return Method.
  - 3.4.2. External/Modified Rate of Return Method.
- 3.5. Public Sector Economic Analysis (Benefit Cost Ratio Method).
- 3.6. Introduction to Lifecycle Costing
- 3.7. Introduction to Financial and Economic Analysis

4. Comparative Analysis of Alternatives [6 hours]
- 4.1. Comparing Mutually Exclusive Alternatives having Same useful life by
  - 4.1.1. Payback Period Method and Equivalent Worth Method
  - 4.1.2. Rate of Return Methods and Benefit Cost Ratio Method
- 4.2. Comparing Mutually Exclusive Alternatives having different useful lives by
  - 4.2.1. Repeatability Assumption
  - 4.2.2. Co-terminated Assumption
  - 4.2.3. Capitalized Worth Method
- 4.3. Comparing Mutually Exclusive, Contingent and Independent Projects in Combination.

5. Replacement Analysis: [6 hours]
- 5.1. Fundamentals of Replacement Analysis
  - 5.1.1. Basic Concepts and Terminology
  - 5.1.2. Approaches for Comparing Defender and Challenger
- 5.2. Economic Service Life of Challenger and Defender
- 5.3. Replacement Analysis When Required Service Life is Long.
  - 5.3.1. Required Assumptions and Decision Framework
  - 5.3.2. Replacement Analysis under the Infinite Planning Horizon
  - 5.3.3. Replacement Analysis under the Finite Planning Horizon

6. Risk Analysis [6 hours]
- 6.1. Origin/Sources of Project Risks.
- 6.2. Methods of Describing Project Risks.
  - 6.2.1. Sensitivity Analysis
  - 6.2.2. Breakeven Analysis
  - 6.2.3. Scenario Analysis
- 6.3. Probability Concept of Economic Analysis
- 6.4. Decision Tree and Sequential Investment Decisions

7. Depreciation and Corporate Income Taxes [6 hours]

7.1. Concept and Terminology of Depreciation
7.2. Basic Methods of Depreciation
  7.2.1. Straight line method
  7.2.2. Declining Balance Method
  7.2.3. Sinking Fund Method,
  7.2.4. Sum of the Year Digit Method
  7.2.5. Modified Accelerated Cost Recovery System (MACRS)
7.3. Introduction to Corporate Income Tax.
7.4. After Tax Cash flow Estimate.
7.5. General Procedure for Making After Tax Economic Analysis.

8. Inflation and Its Impact on Project Cashflows. [4 hours]

8.1. Concept of Inflation.
8.2. Measuring Inflation
8.3. Equivalence Calculation Under Inflation
8.4. Impact of Inflation on Economic Evaluation

Tutorials:

1. Assignments,
2. Quizzes and 1 Case study.

References:

Chan S. Park, *Contemporary Engineering Economics,* Prentice Hall, Inc.
E. Paul De Garmo, William G. Sullivan and James A. Bonta delli, *Engineering Economy,* MC Milan Publishing Company.
James L. Riggs, David D. Bedworth and Sabah U. Randhawa, *Engineering Economics,* Tata MCGraw Hill Education Private Limited.

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	3	4
2	6	6
3	8	16
4	6	12
5	6	12
6	6	12
7	6	12
8	4	6
Total	45	80

* There may be minor variation in marks distribution

SANITARY ENGINEERING
CE ….

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

Course Objective:
Sanitary Engineering course aims at providing the students with a complete knowledge on wastewater collection, conveyance, treatment , disposal methods and design. The course will provide the knowledge of sludge and solid waste management. After completing the course, the students are expected to solve the problems of wastewater and solid waste management.

1. **Introduction** **[2 hours]**
   - 1.1. Difinitions of common terms - Sewage/Wastewater, Domestic sewage, Industrial sewage, Sanitary sewage, Storm water, Sullage, Sewer, Sewerage, Rubbish, Garbage, Refuse/Solid waste
   - 1.2. Importance of Wastewater and Solid Waste Managements
   - 1.3. Wastewater and Solid waste management methods - Collection, Conveyance, Treatment and Disposal
   - 1.4. Objectives of sewage disposal
   - 1.5. Sanitation systems
     - 1.5.1. Conservancy system with merits and demerits
     - 1.5.2. Water carriage system with merits and demerits
   - 1.6. Sewerage systems and types
     - 1.6.1. Separate system
     - 1.6.2. Combined system
     - 1.6.3. Partially separe system
     - 1.6.4. Comparison between separate and combined systems

2. **Quantity of Wastewater** **[4 hours]**
   - 2.1. Dry Weather Flow (DWF) and Wet Weather Flow (WWF)
   - 2.2. Sources of sanitary sewage
     - 2.2.1. Private and public water supplies
     - 2.2.2. Groundwater infiltration
     - 2.2.3. Unauthorized connections
   - 2.3. Factors affecting quantity of sanitary sewage
     - 2.3.1. Population
     - 2.3.2. Rate of water supply
     - 2.3.3. Groundwater infiltration
     - 2.3.4. Unauthorized connections
   - 2.4. Determination of quantity of sanitary sewage, peak factor, peak flow
   - 2.5. Determination of quantity of storm water
     - 2.5.1. Rational method and its limitation
     - 2.5.2. Overall runoff coefficient
     - 2.5.3. British ministry of Health formula for intensity of rainfall
     - 2.5.4. Time of concentration
   - 2.6. Numericals on determination of quantity of wastwater for separate, combined and partially separate systems

3. **Design and Construction of Sewers** **[4 hours]**
   - 3.1. Design criteria of sewers
     - 3.1.1. Specific gravity of wastewater
     - 3.1.2. Design period
     - 3.1.3. Minimum and Maximum velocities, Self cleanising velocity
     - 3.1.4. Sewer size range
     - 3.1.5. Sewer gradient
     - 3.1.6. Hydraulic formulae for design - Manning's, Chezy's and Hazen Williams formulae
     - 3.1.7. Hydraulic elements of sewers for partial flow condition
     - 3.1.8. Partial flow diagrams
   - 3.2. Shapes of sewers - Circular and non-circular sections with merits and demerits
   - 3.3. Sewer Materials
     - 3.3.1. Requirements of sewer materials
     - 3.3.2. Types of sewer materials - salt galzed stoneware, cement concrete, cast iron
   - 3.4. Design of sewers of separate and combined systems
   - 3.5. Numericals on design of sewers
   - 3.6. Construction of sewers
     - 3.6.1. Setting out
     - 3.6.2. Alignment and gradient
     - 3.6.3. Excavation of trench
     - 3.6.4. Timbering of trench
     - 3.6.5. Dewatering of trench
     - 3.6.6. Laying and jointing
     - 3.6.7. Testing of sewer - Straightness, Obstruction, Water and Air tests
     - 3.6.8. Backfilling of trench

4. Sewer Appurtenances [3 hours]

4.1. Necessity of sewer appurtenances
4.2. Construction of sewer appurtenances
  4.2.1. Manhole
  4.2.2. Drop manhole
  4.2.3. Lamphole
  4.2.4. Street inlets
  4.2.5. Catch basin
  4.2.6. Flushing device
  4.2.7. Sand, grease and oil traps
  4.2.8. Inverted siphon
  4.2.9. Sewer outlet
  4.2.10. Ventilating shaft

5. Characteristics and Examination of Wastewater [5 hours]

5.1. Characteristics of wastewater
  5.1.1. Physical characteristics - colour, odour, temperature and turbidity
  5.1.2. Chemical characteristics - pH, organic and inorganic solids, nitrogenous compounds
  5.1.3. Biological characteristics – bacteria
5.2. Sampling of wastewater
  5.2.1. Grab and composite samples
  5.2.2. Preservation and storing
5.3. Decomposition of wastewater-process, Aerobic and anaerobic decomposition, Stale sewage
5.4. Biochemical Oxygen Demand (BOD)
  5.4.1. Definition of BOD and its significance
  5.4.2. Derivation of BOD equation
  5.4.3. Rate reaction, ultimate BOD and relation with temperature
  5.4.4. Numericals on BOD
5.5. Chemical oxygen Demand (COD) - Definition and significance
5.6. Examination of wastewater
  5.6.1. Necessity of wastewater examination
  5.6.2. Examination of volatile, fixed and total solids, settleable and non-settleable solids, BOD with and without dilution, COD
5.7. Numericals on BOD test

6. Wastewater Disposal [6 hours]

6.1. Necessity and objectives of wastewater disposal
6.2. Wastwwater disposal methods - Dilution and Land treatment
6.3. Wastewater disposal by Dilution process and essential conditions for dilution
6.4. Self purification of rivers/streams
6.5. Factors affecting self purification - Dilution, Current, Sunlight, Sedimentation, Temperature, Oxidation, Reduction
6.6. Oxygen sag curve
6.7. Streeter Phelp's equation (Derivation not required)
6.8. Numerical on self purification of rivers/streams
6.9. Watewater disposal by land treatment
  6.9.1. Suitability of land treatment
  6.9.2. Methods of land treatment - irrigation, overland flow and rapid infiltration
  6.9.3. Broad irrigation and sewage farming
  6.9.4. Methods of application of sewage on land - flooding, surface irrigation, ridge and furrow method, subsurface irrigation and spray irrigation
  6.9.5. Sewage sickness and its prevention

7. Wastewater Treatment [12 hours]

7.1. Objectives of wastewater treatment
7.2. Treatment process types and impurity removal
7.3. Primary treatment process
  7.3.1. Racks and Screens - purpose and types (Bar, Coarse and Fine screens)
  7.3.2. Skimming tank - purpose and construction
  7.3.3. Grit chamber - purpose, construction and design criteria
  7.3.4. Sedimentation - purpose, types and design criteria
  7.3.5. Chemical precipitation - purpose, mixing and flocculation (introduction only)
  7.3.6. Numericals on design of Grit chamber and Sedimentation tank
7.4. Biological (Secondary) treatment process
  7.4.1. Objectives of biological treatment process
  7.4.2. Principles of biological treatment process - Attached and Suspended growth processes
  7.4.3. Types of biological treatment process
7.5. Sewage filtration
  7.5.1. Filter types
  7.5.2. Intermittent sand filter - purpose, construction, working and cleaning with merits and demerits

7.5.3. Contact bed - purpose, construction, working and cleaning with merits and demerits
7.5.4. Trickling filter - purpose, construction, working and cleaning with merits and demerits, types (high rate and standard rate), recirculation, two stage filters, design criteria
7.5.5. Numericals on design of trickling filters

7.6. Activated sludge process
7.6.1. Principles of activated sludge process
7.6.2. Construction and process description
7.6.3. Aeration methods
7.6.4. Design criteria
7.6.5. Advantages and disadvantages
7.6.6. Sludge volume index
7.6.7. Numericals on activated sludge process

7.7. Oxidation ponds
7.7.1. Purpose of oxidation ponds
7.7.2. Theory of oxidation ponds
7.7.3. Construction of oxidation ponds
7.7.4. Commissioning
7.7.5. Operation and maintenance
7.7.6. Design criteria
7.7.7. Advantages and disadvantages
7.7.8. Numericals on oxidation ponds

8. Sludge Treatment and Disposal [4 hours]

8.1. Sources of sludge
8.2. Necessity of sludge treatment
8.3. Characteristics of sludge
8.4. Determination of sludge volume, volume - moisture relation
8.5. Sludge treatment methods
8.5.1. Grinding and blending
8.5.2. Thickening - Gravity thickener, purpose, construction and loading criteria
8.5.3. Digestion - Aerobic and anaerobic digestion, digestion process, control of digestion, construction and design criteria of digester
8.5.4. Dewatering - Vacuum filtration (purpose and construction)
8.5.5. Drying - Sludge drying beds (purpose and construction)
8.5.6. Composting - purpose, principles, types (windrow and mechanical)
8.5.7. Incineration - purpose and construction
8.6. Numericals on sludge volume determination and design of digester
8.7. Sludge disposal methods
8.7.1. Dumping
8.7.2. Land filling
8.7.3. Lagooning
8.7.4. Spreading on land

9. Disposal of Sewage from Isolated Buildings [3 hours]

9.1. Necessity
9.2. On site sanitation - Definition and types
9.3. Pit privy - purpose and construction
9.4. Ventilated Improved Pit (VIP) latrine - purpose, construction, design criteria, types (single pit, double pits and multiple pits), advantages and disadvantages
9.5. Pour flush latrine - purpose, construction and design criteria
9.6. Septic tank - purpose, construction, design criteria, working and maintenance
9.7. Septic tank effluent disposal methods
9.7.1. Drain field - purpose, construction and design criteria
9.7.2. Soak pit - purpose, construction and design criteria
9.7.3. Evapotranspiration mound - purpose and construction
9.7.4. Leaching cesspool - purpose and construction
9.8. Numericals on design of ViIP latrine, Pour flush latrine, Septic tank, Drain field and Soak pit

10. Solid Waste Disposal [2 hours]

10.1. Characteristic of solid waste
10.2. Quantity of solid waste
10.3. Collection and transportation of solid waste
10.4. Solid waste disposal methods
10.4.1. Dumping
10.4.2. Sanitary landfill
10.4.3. Incineration
10.4.4. Composting

References:

1. B. C. Punmia and Ashok Jain, "Wastewater Engineering", Laxmi Publications (P) Ltd., New Delhi, 1998
2. P.N. Modi, "Sewage Treatment & Disposal and Wastewater Engineering", Standard Book House, Delhi, 2001
3. G.S. Birdie and J,S, Birdie, "Water Supply and Sanitary Engineering",

Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2002
4. K.N. Duggal, "Elements of Environmental Engineering", S. Chand and Company Ltd., New Delhi, 1997

Tutorials:

1. **Quantity of Wastewater** **(2 hour)**
   Definitions, Numericals on determination of sanitary sewage and storm water, determination on quantity of wastewater for separate, combined and partially separate systems
2. **Design and Construction of Sewers** **(2 hours)**
   Design criteria of sewers, partial flow conditions in sewers, Numericals on design of sewers for separate and combined systems
3. **Sewer Appurtenances** **(0 hour)**
4. **Characteristics and Examination of Wastewater** **(2 hours)**
   Definitions, Numericals on BOD and BOD testing
5. **Wastewater Disposal** **(2 hours)**
   Definitions, Streeter-Phelp's equation description, Numericals on purification of rivers/streams and degree of treatment required
6. **Wastewater Treatment** **(3 hours)**
   Definitions, Numericals on grit chamber, sedimentation tank, trickling filter, activated sludge process and oxidation pond
7. **Sludge Treatment and Disposal** **(2 hours)**
   Definitions, Numerical on sludge volume determination, volume-moisture relation and design of digesters
8. **Disposal of Sewage from Isolated Buildings** **(2 hours)**
   Definitions, Numericals on design of VIP latrine, Pour flush latrine, Septic tank, Drain field and Soak pit
9. **Solid Waste Disposal** **(0 hour)**

Evaluation Scheme:

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

Chapters	Lecture Hours	Tutorial Hours	Marks Distribution*
1	2	0	4
2	4	2	4
3	4	2	8
4	3	0	4
5	5	2	8
6	6	2	8
7	12	3	24
8	4	2	8
9	3	2	8
10	2	0	4
Total	45	15	80

* There may be minor variation in marks distribution

TRANSPORTATION ENGINEERING I
EG … CE

Lecture : 3 **Year : III**
Laboratory : 2/2 **Part : II**
Tutorial : 1

Objective:
After the completion of the course, students will be able to plan, survey and design the road projects. They will attain the knowledge of road development and its planning. They will gain the knowledge based on the Nepalese context.

1. Introduction to Transportation Planning and engineering [4 hours]

1.1. Introduction
1.2. Modes of Transportation
1.3. Comparison between Various Modes of Transportation
1.4. Historical Development of Roads and Road Construction in Nepal
1.5. Transport Planning including Objective of Road Planning, National Network Planning, Urban Road Network Planning and Ring Roads
1.6. Classification of Roads (NRS)

2. Highway Alignment and Engineering Survey [4 hours]

2.1. Highway Alignment
  2.1.1. Introduction
  2.1.2. Requirements of Highway Alignment
  2.1.3. Factors Controlling Highway Alignment
2.2. Engineering Survey and its Stages
  2.2.1. Structure of the route Location Process
  2.2.2. Physical Surveys: Map Study, Reconnaissance, Preliminary and Detailed Surveys

3. Geometric Design of Highway [18 hours]

3.1. Definition and Scope of Geometric Design
3.2. Basic Design Controls and Criteria for Design
3.3. Elements of cross-section
3.4. Elements of Horizontal Alignments
  3.4.1. Definition and Types of Horizontal Curve
  3.4.2. Design of Horizontal Curves including Night Visibility Consideration
  3.4.3. Sight Distance: Stopping Sight Distance, Overtaking Sight Distance, Set-back from Obstructions
  3.4.4. Super elevation
  3.4.5. Extra widening
  3.4.6. Transition Curves: Definition and types of Transition Curve, Design of Transition Curve
3.5. Elements of Vertical Alignment
  3.5.1. Definition and types of Gradient
  3.5.2. Momentum Grade
  3.5.3. Grade Compensation
  3.5.4. Definition and Types of Vertical Curve
  3.5.5. Design of Vertical Summit curve
  3.5.6. Design of Vertical Valley Curve
  3.5.7. Lowest and highest point of Vertical Curve

4. Highway Drainage [4 hours]

4.1. Introduction and Importance of Highway Drainage System
4.2. Causes of Moisture Variation in Sub-grade Soil
4.3. Surface Drainage System
  4.3.1. Different types of Road Side Drain
  4.3.2. Cross drainage structures (Culverts and others)
  4.3.3. Different Types of Energy Dissipating Structures
4.4. Subsurface Drainage System
  4.4.1. Drainage of Infiltrated Water
  4.4.2. Control of Seepage Flow
  4.4.3. Lowering of Water Table
  4.4.4. Control of Capillary Rise

5. Hill Roads [5 hours]

5.1. Introduction
5.2. Special Consideration in Hill Road Design
  5.2.1. Alignment of Hill Road Design: General Consideration, Route Location in Hills, Gradient, Design and Types of Hair Pin Bends, Different Types of Hill Road Cross Sections
5.3. Special Structures in Hill Road

5.3.1. Types of Retaining Structures, River Training Structures, Land Slide Stabilization Structures and Gully Control Structures

6. Highway Materials [10 hours]

6.1. Introduction and Classification of Road Materials

6.2. Sub-grade Soil

6.2.1. General

6.2.2. Characteristics of Sub-grade Soil

6.2.3. Desirable Properties of Sub-grade Soil

6.3. Road Aggregate

6.3.1. Definition and Classification of Road Aggregates

6.3.2. Desirable Properties of Road Aggregates

6.3.3. Tests on Road Aggregates and their Significance

6.3.4. Comparing Gradation Specification and Method of Translating Specification

6.3.5. Combining of the Aggregates

6.4. Bituminous Road Binders

6.4.1. Definition and Classification of Road Binders

6.4.2. Liquid Bitumen: Cut-back Bitumen and Bitumen Emulsion

6.4.3. Tests on Bituminous Binders

6.5. Bituminous Mixes

6.5.1. Definition and Classification

6.5.2. Marshal Method of Bitumen Mixe Design

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

Laboratories:
(a) Los Angeles Abrasion Value and Crushing Value of Aggregates
(b) Penetration Value; Viscosity; Softening Point and Ductility of Bitumen
(c) Skid Resistance Test on Road Surface
(d) Marshall Stability Test and Asphalt Mix Design
(e) Extraction of Bitumen from Mix and Gradation of Aggregate after Extraction

Reference Books:

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

Evaluation Scheme:

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

Chapter	Hours	Mark distribution*
1.	4	8
2.	4	8
3.	18	32
4.	4	8
5.	5	8
6.	10	16
Total	45	80

* There may be minor variation in marks distribution

IRRIGATION AND DRAINAGE ENGINEERING
CE ….

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

Course Objectives:
This course is aimed at teaching students to develop know how in planning, design, development, operation, maintenance & management of irrigation the demand analysis of irrigation, methods of irrigation, components of an irrigation system and layout of irrigation structures. The course is designed to plan the irrigation system, to design irrigation structures and to manage the irrigation system.

11. Introduction [4 hours]
- 1.1. Definition, advantages and disadvantages of irrigation
- 1.2. Status and need of irrigation development in Nepal
- 1.3. Crops, their seasons and periods (Cropping pattern & intensity)
- 1.4. Commanded areas and Irrigation intensity
- 1.5. Methods of field irrigation and their suitability
- 1.6. Planning of irrigation projects

2. Irrigation Water Requirements [4 hours]
- 2.1. Relation between Duty, Delta and crop periods
- 2.2. Crop Water Requirements (Penman's method)
- 2.3. Operational water requirements
- 2.4. Water losses due to seepage and evaporation
- 2.5. Effective Rainfall
- 2.6. Irrigation Water Requirements
- 2.7. Soil-Moisture-Irrigation Relationship
- 2.8. Depth and Frequency of Irrigation
- 2.9. Irrigation efficiencies
- 2.10. Design discharges for canals

3. Canal Irrigation System [3 hours]
- 3.1. Classification of canals
- 3.2. Components of a canal irrigation system
- 3.3. Alignment of canals
- 3.4. Alluvial and Non-alluvial canals
- 3.5. Canal standards and Balancing canal depth
- 3.6. Canal distribution system

4. Design of Canals [6 hours]
- 4.1. Design capacity of canals
- 4.2. Sediment transport in canals
- 4.3. Tractive Force approach of canal design
- 4.4. Design of stable canals
- 4.5. Design of Alluvial canals (Kennedy's & Lacey's Theory)
- 4.6. Design of lined canals with economic analysis

5. Diversion Headworks [8 hours]
- 5.1. Component parts of Weir/Barrage (Detail drawing)
- 5.2. Bligh's, Lane's and Khosla's seepage theory
- 5.3. Design of sloping glacies weir bay (crest, length & thickness of impervious floor)
- 5.4. Design of Undersluice and Silt excluder
- 5.5. Design of Silt ejector
- 5.6. Design of Head Regulator (Crest, length & thickness of impervious floor)

6. River Training Works [4 hours]
- 6.1. River stages and Need of river training
- 6.2. Types of river training works
- 6.3. Design of Guide bunds and Launching apron
- 6.4. Design of Spurs (Layout geometry, length, spacing and cross-section)

7. Regulating Structures [6 hours]
- 7.1. Alignment of the off-taking channels
- 7.2. Function of Head regulator, Cross regulator, Outlet, Drop and Escapes
- 7.3. Design of Regulators & Escapes (Crest, length and thickness of impervious floor)
- 7.4. Types of Outlet, Design of pipe outlet (free and submerged)
- 7.5. Types of Drop, Design of Vertical drop (Crest, length and thickness of impervious floor)

8. Cross-Drainage structures [4 hours]
- 8.1. Types (Drawing and Selection)
- 8.2. Design of Siphon Aqueduct (Detail drawing, Drainage waterway & barrel, Canal waterway & Transition, Length & thickness of impervious floor and Protection works)

9. Water Logging and Drainage [6 hours]

9.1. Causes, effects and preventive measures of water logging
9.2. Water logging and drainage of irrigated land
9.3. Surface drainage systems and their design
  9.3.1. Layout planning for Drainage
  9.3.2. Internal drainage of Bunded fields
  9.3.3. External drainage
  9.3.4. Drain design (water level, maximum & minimum slopes and cross-sections)
  9.3.5. Remodeling of existing natural drains
9.4. Subsurface drainage systems and their design
  9.4.1. Layout of subsurface drainage system
  9.4.2. Flow of ground water to drains and spacing of tile drains

Tutorials: **[30 hours]**

1. Duty, Delta and Period Relation [1 hour)
2. Irrigation Water Requirements (2 hoours)
3. Soil-Moisture-Irrigation Relation and Irrigation Interval (2 hours)
4. Balancing depth for excavating canals (1 hour)
5. Design of stable canals (1 hour)
6. Design of Alluvial canals (2 hours)
7. Design of lined canals (1 hour)
8. Design of Guide Bunds and Launching Apron (2 hours)
9. Design of hydraulic structures using Khosla's Seepage Theory (4 hours)
10. Design of sloping glacies Weir bay (2 hours)
11. Design of Cross & Head Regulators (3 hours)
12. Design of pipe outlet (1 hour)
13. Design of Vertical Drop (2 hpurs)
14. Design of Siphon Aqueduct (4 hours)
15. Design of surface and sub-surface drains (2 hours)

Assignments & Field Visit:

1. Individual assignment on Irrigation Water Requirement using CROPWAT Software
2. Field visit of an Irrigation System, group presentation and submission of individual report

Reference books:

1. "Theory and design of irrigation structures", volume I and II, R S Varshney, S C Gupta and R L Gupta, Nem Chand and Bros., Roorkee, 1979
2. Irrigation Engineering and Hydraulic Structures, S K Garg, Delhi, 1983
3. Irrigation Engineering, Gurcharan Singh
4. Design Manuals for Irrigation projects in Nepal, PDSP Manuals, M.9 Drainage Manual, 1990
5. Hydraulic Structures, P. Novak et.al., SPON PRESS, 2001

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	5
2.	4	8
3.	3	5
4.	6	10
5.	8	12
6.	4	8
7.	6	12
8.	4	10
9.	6	10
Total	45	80

* There may be minor variation in marks distribution