



**ANDHRA UNIVERSITY**  
**DEPARTMENT OF CIVIL ENGINEERING**

**SCHEME AND SYLLABI**  
**(Effective from 2020-21 Admitted Batch)**

**B.Tech & B.Tech. +M.Tech**  
**III Year - I Semester**

| Course code          | Category | Course Title                                   | Hours per week |   | Internal Marks | External Marks | Total Marks | Credits   |
|----------------------|----------|--|----------------|---|----------------|----------------|-------------|-----------|
|                      |          |  | L              | P |                |                |             |           |
| CV3101               | PC       | Reinforced Concrete Structures                 | 4              | 0 | 30             | 70             | 100         | 3         |
| CV3102               | PC       | Steel Structures                               | 4              | 0 | 30             | 70             | 100         | 3         |
| CV3103               | PC       | Geotechnical Engineering-II                    | 4              | 0 | 30             | 70             | 100         | 3         |
| CV3104               | PE       | Professional Elective-I                        | 4              | 0 | 30             | 70             | 100         | 3         |
| CV3105               | OE       | Open Elective-I                                | 4              | 0 | 30             | 70             | 100         | 3         |
| CV3106               | PC       | Geotechnical Engineering - II Lab              | 0              | 3 | 50             | 50             | 100         | 1.5       |
| CV3107               | PC       | Environmental Engineering Lab                  | 0              | 3 | 50             | 50             | 100         | 1.5       |
| CV3108               | SC       | Computer Applications in Civil Engineering Lab | 1              | 2 | 50             | 50             | 100         | 2         |
| CV3109               | INT      | Internship - I                                 |                |   | 50             | 50             | 100         | 2         |
| <b>Total Credits</b> |          |  |                |   |                |                |             | <b>22</b> |

**B.Tech & B.Tech. +M.Tech  
III Year - II Semester**

| Course code     | Category | Course Title                                 | Hours per week |   | Internal Marks | External Marks | Total Marks | Credits |
|-----------------|----------|--|----------------|---|----------------|----------------|-------------|---------|
|                 |          |  | L              | P |                |                |             |         |
| CV3201          | PC       | Transportation Engineering                   | 4              | 0 | 30             | 70             | 100         | 3       |
| CV3202          | PC       | Engineering Economics Estimation and Costing | 4              | 0 | 30             | 70             | 100         | 3       |
| CV3203          | PC       | Structural Analysis-II                       | 4              | 0 | 30             | 70             | 100         | 3       |
| CV3204          | PE       | Professional Elective-II                     | 4              | 0 | 30             | 70             | 100         | 3       |
| CV3205          | OE       | Open Elective-II                             | 4              | 0 | 30             | 70             | 100         | 3       |
| CV3206          | PC       | Computer Aided Analysis and Design Lab       | 0              | 3 | 50             | 50             | 100         | 1.5     |
| CV3207          | PC       | Fluid Mechanics - II Lab                     | 0              | 3 | 50             | 50             | 100         | 1.5     |
| CV3208          | PC       | Highway Materials Lab                        | 0              | 3 | 50             | 50             | 100         | 1.5     |
| CV3209          | SC       | Soft Skills                                  | 1              | 2 | 50             | 50             | 100         | 2       |
| Total Credits   |          |  |                |   |                |                |             | 21.5    |
| Internship - II |          |  |                |   |                |                |             |         |

**B.Tech & B.Tech. +M.Tech  
IV Year - I Semester**

| Course code   | Category | Course Title                                       | Hours per week |   | Internal Marks | External Marks | Total Marks | Credits |
|---------------|----------|--|----------------|---|----------------|----------------|-------------|---------|
|               |          |  | L              | P |                |                |             |         |
| CV4101        | PE       | Professional Elective-III                          | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4102        | PE       | Professional Elective-IV                           | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4103        | PE       | Professional Elective-V                            | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4104        | OE       | Open Elective-III                                  | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4105        | OE       | Open Elective-IV                                   | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4106        | HSSE     | Elective   | 4              | 0 | 30             | 70             | 100         | 3       |
| CV4107        | SC       | Quality Evaluation of Civil Engineering Structures | 1              | 2 | 50             | 50             | 100         | 2       |
| CV4108        | INT      | Internship - II                                    |                |   | 50             | 50             | 100         | 2       |
| Total Credits |          |  |                |   |                |                |             | 22      |

**B.Tech & B.Tech. +M.Tech  
IV Year - II Semester**

| Course code   | Category | Course Title | Internal Marks | External Marks | Total Marks | Credits |
|---------------|----------|--------------|----------------|----------------|-------------|---------|
| CV4201        | PROJ     | Project work | 100            | 100            | 200         | 14      |
| Total Credits |          |              |                |                |             | 14      |

### **Professional Electives**

1. Hydraulic and Irrigation Structures
2. Matrix Methods of Structural Analysis
3. Introduction to Rock Mechanics
4. Advanced Design of Structures
5. Hydraulic Machines
6. Geo-Environmental Engineering
7. Remote Sensing and GIS Applications
8. Earth Retaining Structures
9. Repair and Retrofitting of structures
10. Railways and Harbour Engineering
11. Environmental Impact Assessment
12. Bridge Engineering
13. Industrial Waste Treatment
14. Traffic Engineering and Management
15. Finite Element Method of Analysis

### **Open Electives**

1. Sanitary Engineering
2. Watershed Management
3. Elements of Earthquake Engineering
4. Prestressed Concrete Structures
5. Elements of Coastal Engineering
6. Sub-soil Exploration and Insitu Soil Testing
7. Air Pollution and Control
8. Design and Detailing of Reinforced Concrete and Steel Structures
9. Analysis and Design of Pavements
10. Project Planning and Management
11. Ground Improvement Techniques
12. Solid Waste Management

### **HSS Electives**

1. Industrial Management & Enterprises
2. Organizational Behaviour
3. Operations Research

**B.Tech & B.Tech. +M.Tech**  
**III Year - I Semester**

**CV3101 REINFORCED CONCRETE STRUCTURES**  
**(IS-456 code book is allowed for examination)**

**Course Objective**

- Establish the basic principles of reinforced concrete structural member and system behaviour.
- Explain the basic design philosophy behind the working stress method and Limit State Method of design.
- Introduce the basic principles of the analytical methods and design procedures.
- Impart knowledge of basic structural elements such as slabs, beams, columns, staircases, and isolated footings in the design process.
- Understand the concepts of designing reinforced concrete structures for limit state of collapse.

**Course Outcomes:**

After completion of this course, students will be able

- To understand the IS code of practice for the design of reinforced concrete structural elements.
- To understand the various design philosophies and their differences.
- To understand behaviour of RCC members under flexural and shear.
- Define design stages of reinforced concrete structures.
- To analyse and design basic structural elements like slabs, beams, columns, staircases & isolated footings.

**SYLLABUS**

**General:** Loading standards as per IS 875, Grades of steel and cement, Stress-Strain characteristics of concrete and steel, Introduction to working stress method and Limit State Method (L.S.D.) of design.

Limit State of Collapse of in Flexure: Central Value measures, Measures of distribution, Normal distribution curve. Introduction and Principles of L.S.D., Characteristic load and strengths, Design values, Partial safety factors, Factored loads.

**Limit State of Collapse:** Flexure of R.C.C. beams of rectangular section. Under reinforced, Balanced and over reinforced sections. Compression stress block, Estimation of ultimate

moment by strain compatibility. Guidelines for choosing width, depth and percentage of reinforcements in beams.

Analysis and design of singly reinforced rectangular beams and doubly reinforced beams, design by using SP 16 (Sessional Work Only).

Design of flanged beams (T and L), Effective flange width, Basis of analysis and design, Minimum and Maximum steel in flanged beams, SP 24 in design of beams.

Design of one way and two way slab: Simply supported slabs on all four sides, Moment in two way slabs with corners held down. Choosing slab thickness. Design of restrained slabs (with torsion at corners) I.S. code provisions. Detailing of reinforcement. Load from slabs on supporting beams. Different kinds of loads on slabs including partition walls, Shear in slabs.

**Shear, Torsion and Bond:** Limit state of collapse in shear, types of shear failures. Truss analogy, shear span / depth ratio. Calculation of shear stress, types of shear reinforcement. General procedure for design of beams for shear. Enhanced shear near supports. Shear in slabs, steel detailing. Analysis for torsional moment in a member. Torsional shear stress in rectangular and flanged sections. Reinforcement for torsion in RC beams. Principles of design for combined bending shear and torsion. Detailing of torsion reinforcement – Concept of bond, development length, anchorage, bond, flexural bond.

**Columns:** Short and Long columns, Minimum eccentricity, short column under axial compression, column with helical and tie reinforcement. Short columns subjected to uniaxial and biaxial moments.

Footings: Analysis and design of isolated square and rectangular footings. Design of staircase.

**Text Books:**

1. Limit State of Design of Reinforced Concrete by P. C. Vergheese, Prentice Hall India Learning.
2. Reinforced Concrete Limit state Design by A.K. Jain, Nem Chand & Brothers.
3. R.C.C Design by Unnikrishna Pillai and Devadas Menon, McGraw-Hill

**Reference Books:**

1. Limit State Design of Reinforced Concrete Structures by P. Dayaratnam, P.Sarah, Oxford and IBH Publishers.
2. Reinforced Concrete Structures by R.Park and T.Paulay, Wiley Publishers.

## CV3102 STEEL STRUCTURES

### Course Objective

- To enable the students regarding types of steel material, properties of steel and various tests on steel like yield strength, ultimate strength and breaking strength tests.
- To impart knowledge on various types of rolled steel sections and their classifications.
- To familiarize the students with the concepts of limit state method.
- To make the students to understand code of practice of steel structure which is IS-800:2007.
- To prepare the students in solving different types of numerical problems of steel structures.

### Course Outcomes

- Students will be having sufficient knowledge on different topics of steel structures.
- Understand concepts on different types of connections in steel structures like bolted and welded connections.
- Can do the problems on different topics of steel structures.
- Can understand advantages of steel structures.

## SYLLABUS

**Note: All the designs should be taught in the limit state design method as per IS 800-2007**

**Fundamental Concepts of limit state design of structures,** Different types of rolled steel sections available to be used in steel structures. Stress – Strain relationship for mild steel.

**Bolted connections:** Behavior of bolted joints, Design strength of ordinary black bolts, high strength friction grip bolts, Simple connections, Moment resistant connections.

**Welded Connections:** Advantages of welding, Types and prosperities of welds, Types of joints, weld specifications Design of welded joints subjected to axial load, Eccentric welded connections.

**Tension members:** Types of tension members, Design of strands, slenderness ratio, displacement of tension members, behavior of tension members, modes of failure, factors affecting strength of tension members, angles under tension, design of tension members, Lug angles, splices.

**Compression members:** Possible failure modes, classification of cross-section, behavior of compression members, Effective length, radius of gyration and slenderness of compression members, Allowable stresses in compression, Design of axially loaded compression members,

built up compression members, Laced and Battened columns, eccentrically loaded columns, Column splices.

**Beams:** Beam types, section classifications, lateral stability of beams, Allowable stress in bending, Shear and Bearing stresses, Effective length of compression flange, laterally supported and unsupported beams, Design of built up beams.

Roof trusses: Types of trusses, Economical spacing of roof trusses, loads on roof trusses, Estimation of wind load on roof trusses as per IS : 875. Design of members of roof truss and joints, Design of purlins.

**Column bases and Foundations:** Allowable stress in bearing, Slab base, Gusset base and Grillage foundations.

Introduction to pre-engineered structures, concepts and advantages, disadvantages.

### **Text Books**

1. Limit State Design of steel structures by S.K.Duggal, McGraw-Hill Education Private Ltd.
2. Design of steel structures by K.S.Sai Ram, Pearson Education India.
3. Limit State Design of steel structures by Ramchandra and Virendra Gehlot, Scientific Publishers (India).

### **Reference Books**

1. Design of Steel structures by N. Subramanian, Oxford University Press.
2. Design of steel structures by Limit State Method as per IS: 800-2007 – S.S. Bhavikatti, IK International Publishing House.

## **CE3103 GEOTECHNICAL ENGINEERING – II**

### **Course Objectives**

- To understand methods of explorations for assessing subsoil characteristics
- To study different methods used for determination of shear strength characteristics of soil.
- To impart knowledge of design of shallow and deep foundation systems and their suitability depending on type of soil and loading conditions.
- To understand various earth pressure theories used for design of earth retaining structures
- To analyse and evaluate stability of soil slopes



**Course Outcomes:**

At the end of the course the student will be able to

- Plan soil exploration programme and prepare a detailed soil investigation report
- Estimate allowable bearing pressure and settlement of soils
- Evaluate stability of various earth retaining structures.
- Gain diverse knowledge on various shallow and deep foundations adopted in field
- Select and design appropriate foundations based on soil characteristics

**SYLLABUS**

**Subsoil Exploration:** Methods of subsoil exploration Direct, semi direct and indirect methods, Soundings by Standard, Dynamic cone and static cone penetration tests, Types of Boring, Types of samples, Criteria for undisturbed samples, Transport and preservation of samples, Borelogs, planning of exploration programmes, report writing.

**Bearing Capacity:** Safe bearing capacity and allowable bearing pressure, Terzaghi's bearing capacity equations its modifications for square, rectangular and circular foundation, General and local shear failure conditions. Factors affecting bearing capacity of Soil. Allowable bearing pressure based on N-values. Bearing capacity from plate load tests.

**Shallow Foundations:** Factors effecting locations of foundation and design considerations of shallow foundations, choice of type of foundations. Foundations on expansive soils.

**Settlement analysis:** causes of settlement, Computation of settlement, allowable settlement. Measures to reduce settlement.

**Pile Foundations:** Types, Construction, load carrying capacity of single pile – Dynamic Formula, Static formula, Pile load tests, Load carrying capacity of pile groups, settlement of pile groups, Negative skin friction.

**Caissons:** Types of caissons, pneumatic caissons, Different shapes of well foundations. Relative advantages and disadvantages. Different Components of well and their function. Grip length, problems in well sinking and remedial measures.

**Stability Analysis of Slopes:** Finite Slopes Fellinius slip circle method, Friction Slip circle method and Taylor's stability numbers, types of failure of finite slopes – Toe slope and Base failure. Infinite slope, factors of safety.

**Earth Pressure:** Types of Earth pressure. Rankines Active and passive earth pressure, Smooth Vertical wall with horizontal backfill. Extension to Soil Coloumbs wedge theory, Culmans and Rebhanns graphical method for active earth pressure. Bulkheads – Classifications, Cantilever

sheet Piles in Sandy soils and clay soils. Analysis of Anchored bulkheads – free earth support and fixed earth support methods.

### **Text Books**

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publishers
2. Soil Mechanics and Foundation Engineering by K.R. Arora, Standard Publishers.

### **Reference Books**

1. Foundation Engineering by P.C. Varghese, Prentice Hall of India
2. Foundation Analysis and Design by J. E. Bowles, Mc Graw-Hill Publishing Co.

## **CV3104 PROFESSIONAL ELECTIVE-I**

### **CV 3105 OPEN ELECTIVE -I**

### **CV 3106 GEOTECHNICAL ENGINEERING - II LAB**

#### **Course Objectives**

- To develop skills to identify and classify different types of soils
- To impart knowledge about different methods of determination of insitu density of soils
- To study the necessity of sedimentation analysis for classifying fine grained soils
- To assess the drainage capacity of different soils
- To understand laboratory methods used for determining density of soil

#### **Course Outcomes**

Upon successful completion of the course student will be able to

- Perform suitable tests for assessing grain size distribution and classify the soil accordingly
- Select appropriate method for determining field density of soil for a given soil
- Determine specific gravity of coarse and fine grained soils<sup>3</sup>
- Evaluate Permeability of given soil
- Estimate compaction characteristics of soil

#### **LIST OF EXPERIMENTS**

1. Determination of Specific Gravity of Coarse Grained and Fine-Grained Soils
2. Determination of Atterberg Limits of Clay

3. Determination of Field Density by Core Cutter and Sand Replacement Methods
4. Determination of Grain Size Distribution of Coarse Grained Soil by Sieve Analysis
5. Determination of Grain Size Distribution of Fines Fraction of Soil by Hydrometer/pipette Analysis.
6. Determination of Coefficient Permeability of Coarse Grained Soil by Constant Head Permeability Test
7. Determination of Coefficient Permeability of Fine Grained Soil by Variable (Falling) Head Permeability Test
8. Determination of Compaction Characteristics of Soil by IS Light / Heavy Compaction Test.
9. Demonstration Experiments:
  1. Rapid Moisture Meter Test for Quick Determination of Water Content
  2. Determination of Water Content of Compacted Soil in Field by Proctor's Plasticity Needle

#### **Reference Books**

1. Relevant IS Codes of Practice

## **CV 3107 ENVIRONMENTAL ENGINEERING LAB**

#### **Course Objectives:**

- To impart knowledge about the physical, chemical, and biological characteristics of water
- To enable the student to optimize the coagulation dose.
- To provide knowledge about the breakpoint chlorination, available chlorination, and residual chlorine.
- To assess the quality of water by physical, chemical biological characteristics relative to standard drinking water standards.
- To evaluate the quality of wastewater without being hazardous as effluent from industries.

#### **Course Outcomes:**

Students will be able to

- Perform common environmental experiments relating to water and wastewater to assess the quality.
- Statistically analyse and interpret laboratory results.
- Apply the laboratory results to identify the problem and give real-time technical solutions.
- Understand the procedures for water and wastewater sampling and sample preservations.
- Understand the effect of water and wastewater treatment on people and the environment.

## **LIST OF EXPERIMENTS**

1. Determination of pH and Conductivity of a given water and wastewater sample
2. Measurement of Turbidity using Nephelometric Turbid meter and Determination of optimum coagulant dosage (Jar Test). Estimation of Total Solids: Settleable Solids: Suspended solids, dissolved solids
3. Determination of Hardness in a given water sample
4. Estimation of Acidity of a water sample
5. Estimation of Alkalinity of a waste and wastewater sample
6. Determination of Available Chlorine, estimation of Fluorides and iron in a given water sample.
7. Measurement of D.O. by volumetric analysis
8. Estimate the B. O. D. of a wastewater sample.
9. Estimate the C. O. D. of a wastewater sample.

### **Text Books**

1. Environmental Engineering Laboratory Manual by Kotaiah, B. and Kumara Swamy, N. Charotar Pub. House.
2. Chemical Analysis of Water and Soil: A laboratory Manual by Muralikrishan K.V.S.G., Envir. Prot. Society.

## **CV 3108 COMPUTER APPLICATIONS IN CIVIL ENGINEERING LAB**

### **Course Objectives:**

- Explore features of 'C/ Fortran 77' language and its use in Civil Engineering computations.
- Develop 'C/ Fortran 77' Programmes for various Civil Engineering problems.
- Design columns, footings, singly and doubly reinforced beams by executing C/ Fortran 77 program.
- Evaluate minor losses in pipes and runoff for a catchment by applying C/ Fortran 77 language.
- Determine the physical characteristics of water and bearing capacity of soils by compiling a program using C/ Fortran 77.

### **Course Outcomes:**

On completion of this course, the student will be able to:

- Evaluate shear force, bending moment and deflection for various types of beams subjected to different loads by executing 'C/ Fortran 77' program.
- Analyze and design columns, footings, singly and doubly reinforced beams by using C/Fortran 77 language.

- Determine runoff of a catchment, friction factor and minor losses in pipes by writing C/Fortran 77 programs and executing them.
- Compile C/Fortran 77 programs for conversion of angles from WCB to RB and classification of soils.
- Evaluate bearing capacity of soils and physical characteristics of water by executing C/Fortran 77 programs.

**LIST OF COMPUTER PROGRAMS USING C/ FORTRAN 77 LANGUAGE:**

1. Determination of shear force, bending moment, deflection for different loading conditions for a simply supported beam and cantilever beam.
2. Determination of fixed end moments for different loading conditions of a fixed beam.
3. Analysis and design of singly and doubly reinforced beams.
4. Analysis and design of columns and footings.
5. Estimation of runoff for a catchment.
6. Estimation of friction factor for laminar and turbulent flows, minor losses in pipe flow.
7. Conversion of angles from WCB to RB.
8. Classification of soils, determination of coefficient of permeability, degree of consolidation and shear strength of soil.
9. Estimation of bearing capacity of soil in various soils
10. Estimation of physical characteristics of water as per codal provisions.

**B.Tech & B.Tech. +M.Tech**  
**III Year - II Semester**

**CV 3201 TRANSPORTATION ENGINEERING**

**Course Objectives:**

- To impart knowledge about the highways and airports to improve the means of transportation.
- To impart knowledge about the different design aspects of designing a pavement, both flexible and rigid pavements.
- To familiarise the students about the construction activity associated with the highways, railways and airports
- To impart knowledge related to various geometric design elements of a highway like super-elevation, cross-section elements, designing curves, both simple curves and transition curves to add comfort and convenience to the road users.
- To impart knowledge related to geometric design elements of highways.
- To impart knowledge about the components and functions of a railway track.

**Course Outcomes:**

Students will be able to

- Design the geometric elements of highways.
- Design the thickness of highways with material specifications in the component layers
- Control the traffic moving on the highways effectively by facilitating the traffic control devices.
- Can understand the procedure to finalize the alignment of a highway.
- Understand the components of an aircraft and airport.
- Design the drainage facilities for a highway.

**SYLLABUS**

**Highway Engineering I:** Road development in India during twentieth century and twenty first century; Highway planning- Classification of Roads; Highway Alignment; Geometric Design of Highways-Cross-section elements, Sight distances, Horizontal and Vertical alignment, Intersection elements.

Traffic Engineering - Traffic characteristics, Traffic Studies, Traffic flow and Roadway capacity, Traffic regulation and control, Road Intersections and their types.

**Highway Engineering II:** Design of Highway Pavements-pavement types, Pavement components and their functions, CBR method of Flexible pavement design, CC pavements-types of stresses in Rigid pavements, Design of Rigid pavements, joints in CC pavements.

Highway Materials - Tests on Road aggregates and desirable properties, Bituminous binders and their properties;

Highway Construction - Construction of Flexible pavements, Construction of CC pavement and joints.

Highway Drainage-Surface and Sub-surface drainage systems.

**Introduction to Airport Engineering:** Aeroplane component parts, Aircraft characteristics, Airport site selection, Runway design, Basic Runway length.

Introduction to Railway Engineering: Railway track components and functions; Rails and Rail failures; Rail joints; Sleepers; Ballast.

#### **Text Books**

1. Highway Engineering by S.K. Khanna, C.E.G. Justo and A. Veeraragavan, Nem Chand
2. Railway Engineering by S.C. Saxena and S. Arora, Dhanpat Rai Publications Pvt. Ltd.
3. Airport planning and Design by Khanna & Arora

#### **Reference Books**

1. Principle and Practice of Highway Engineering by R.C.Sharma and S.K.Sharma, Asia Publishing House.
2. Transportation Engineering by L.R. Kadiyali, Khanna Publications.
3. Principles of Transportation Engineering by Partha Chakraborty, PHI Learning
4. Railway Engineering by Rangwala.

## **CV 3202 ENGINEERING ECONOMICS, ESTIMATION AND COSTING**

#### **Course Objectives:**

- Quantity estimation for different civil engineering works like single storey residential building, BT road, canal etc.
- Quantity estimation and preparing schedule of bars of different items of RC works.
- Rate analysis for different items of work and finding the unit rate of different items of work.
- Cost estimation for different civil engineering works like single storey residential building, BT road, canal etc.

- To prepare a project management report for different civil engineering projects like residential building, BT road, canal etc.

### **Course Outcomes:**

At the end of the course student will be able to

- Estimate quantities required for different civil engineering works like single storey residential buildings, bt road, canal etc.
- Cost estimation for different civil engineering works like single storey residential building, bt road, canal etc.
- Finding the unit rate for different items of work.
- Prepare schedule of reinforcement bars and scheduling a project.
- Analysing a project and finding critical activities and hence allocate resources as per the schedule of project.

## **SYLLABUS**

**Introduction:** standard units, units of measurement of different items of work. Meaning of “estimating”, abstract estimate of buildings, errors in estimation, different types of estimates. Contingencies and related terms in the estimate, different types of approvals. Plinth area and related terms used in the estimation of various structures, rules and methods of measurements of different works.

**Contracts:** types of contracts, contract document, contract procedure, conditions of contract, arbitration and tenders.

**Specifications:** meaning, purpose, types of specifications, method of preparation of specification, general specification, detailed specifications of different items of buildings and other structures.

Rate analysis – data sheet for materials and various items of work in buildings and other structures, schedule of rates. Rate analysis for building works, rate analysis for sanitary and water supply works, rate analysis for road and railway works.

**Detailed estimate of building:** different items of work in building; principles of taking out quantities, detailed measurement form; long walls and short walls method of building estimate, centre line method of building estimate. Estimate of RCC building, estimate of slope roof buildings; G.I. And A.C. Sheet, detailed estimate of different types of doors and windows, estimate of electricity and water supply, sanitation works etc.

**Estimate of earthwork:** different formulae for calculations, estimate of metaled road, tar road, concrete road, railway track, estimate of culverts and bridges etc.



Valuation of buildings: purpose, different method of building valuation; different terms used in valuation and their meaning.

### **Text Books**

1. Estimating and costing in civil engineering by b.n. Dutta, sangam books.
2. Textbook of estimating and costing by g.s. Birdie, dhanpat rai publishing company private limited.

### **Reference Books**

1. Estimation, costing, specifications and valuation in civil engineering by m.chakraborti.
2. Textbook on estimating, costing and accounts by d.d. Kohli and r.c. Kohli, s chand & company pvt. Ltd.

## **CV 3203 STRUCTURAL ANALYSIS – II**

### **Course Objectives:**

- To impart the principles of structural analysis and behaviour of indeterminate structures.
- To impart knowledge about various methods involved in the analysis of indeterminate structures.
- To impart skills of these methods for analyzing the indeterminate structures to evaluate the response of structures.
- To make the student familiar with analysis Arches and Suspension bridges.
- To impart knowledge about matrix methods.

### **Course Outcomes:**

The student after undergoing this course will be able to:

- Analyse indeterminate structures and adopt an appropriate structural analysis technique.
- Determine response of structures by Force, displacement and matrix methods.
- Understand the concept of analysis of Arches and Suspension bridges.

## **SYLLABUS**

Analysis of Statically Indeterminate Trusses (having not more than 7 members and 3 supports) containing (a) External Redundant Supports (b) Internal Redundant Members using (i) Method of Consistent Deformation of Unit Load Method (ii) Castigliano's Theorem – II.

Analysis of Three Span Continuous Beams using Kani's Method, Analysis of Statically Indeterminate Frames (Single Storey, Single Bay Portal Frames only) using (i) Slope-deflection method (ii) Moment Distribution Method (iii) Kani's Method.

**Arches:** Normal Thrust, Radial Shear and Bending Moment in Three Hinged and Two Hinged Parabolic and Segmental Arches. Effects of Rib-shortening and Temperature Change.

**Suspension Bridges:** Stresses in Loaded Cables with Supports at the Same and Different Levels. Length of Cable; Two and Three Hinged Stiffening Girders.

Introduction to Matrix Methods of Structural Analysis (Very elementary treatment only), Static Indeterminacy, Kinematic Indeterminacy, Stiffness and Flexibility Method for Two Span Continuous Beams only– Truss with 3 supports and 7 members.

#### **Text Books**

1. Theory of Structures by S.Ramamrutham, R.Narayan, Dhanpat Rai, Publishing Company.
2. Theory of Structures by B.C.Punmia, Ashok K Jain, Arun K Jain, Laxmi Publications.
3. Mechanics of Structures Vol II by S.B.Junnarkar, H.J.Shah, Charotar Publishing House.

#### **Reference Books**

1. Statically Indeterminate Structures by C.K. Wang, Mcgraw-Hill.

### **CV3204 PROFESSIONAL ELECTIVE – II**

#### **CV 3205 OPEN ELECTIVE –II**

#### **CV 3206 COMPUTER AIDED ANALYSIS AND DESIGN LAB**

#### **Course Objectives:**

- Know the necessity of structural analysis and design software along with its applications.
- Familiarize with the generation of models by using design software.
- Understand the usage of various commands in the software.
- Analyze beams and trusses by generating models using structural analysis and design software.
- Create models for two and three dimensional frames and analyze them by using software.

#### **Course Outcomes:**

- Understand the importance of structural engineering and design software.
- Summarize the applications of different commands in structural analysis and design software.
- Create various structural models by using design software.

- Develop beams and truss models by using structural engineering software.
- Analyze two dimensional and three dimensional frames by generating models by using the software.

## **SYLLABUS**

1. Introduction to structural engineering.
2. Introduction to structural analysis and design software.
3. Applications of various commands in the software.
4. Model generation using structural engineering software.
5. Analysis and design of various structural components of civil engineering and building frames.
  - i. Modeling and analysis of various types of beams.
  - ii. Modeling and analysis of trusses.
  - iii. Modeling and analysis of two dimensional frames.
  - iv. Modeling and analysis of three dimensional frames.

## **CV 3207 FLUID MECHANICS – II LAB**

### **Course Objectives:**

- To provide practical knowledge in verification of principles of fluid flow
- To conduct a test on hydraulic jump and measurement of rugosity coefficients in open channels.
- To understand major losses in pipe flows.
- To understand drag characteristics of cylinder in a wind tunnel e.
- To conduct experiments on impact of jets on vanes.
- To gain knowledge in performance testing of hydraulic turbine and hydraulic pumps at constant speed and head.
- To learn and practice writing technical reports.

### **Course Outcomes:**

- On completion of this course, the student will be able to
- Demonstrate practical understanding in formation of hydraulic jump and measurement of Rugosity coefficients.
- Demonstrate practical understanding of friction losses in pipe flows
- Demonstrate practical understanding of boundary layer, separation and drag
- Provide the student knowledge in calculating performance analysis in turbine and pumps.
- Demonstrate the ability to write clear lab records.

## **LIST OF EXPERIMENTS**

1. Study of Characteristics of a hydraulic jump – To measure and draw  $(E_1 - E_2)/E_1$  vs  $F_1$  and  $L_j / y_2$  vs  $F_1$ , and compare with theoretical results wherever possible.
2. Study of Rugosity coefficients in an open channel flow.
3. Study of major losses in pipes – Pipe friction – To compute Darcy- Weisbach friction factor.
4. Study of impact of a jet on flat and curved vanes.
5. Study of performance characteristics of a centrifugal pump – To measure the discharge, head developed, and power input at various discharges for centrifugal pump and draw the performance characteristics.
6. Study of performance characteristics of a reciprocating pump – To measure the discharge, head developed, and power input at various discharges for reciprocating pump and calculate percentage slip and efficiency.
7. Study of performance characteristics of a Pelton turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.
8. Study of performance characteristics of a Francis turbine – To measure the discharge, head difference across the turbine, the brake load, speed of turbine for various discharges and draw the performance characteristics.

## **CV 3208    HIGHWAY MATERIAL LAB**

### **Course Objectives:**

- To impart knowledge about the tests to be conducted on aggregate for its suitability in pavement construction.
- To familiarise the students about the applicability of aggregate in flexible pavement and rigid pavement respectively.
- To impart knowledge about the procedure to determine the strength of the soil subgrade to take up the pavement component layers of it.
- To make the students understand the tests to be conducted on a sample of bitumen for use in flexible pavements
- To familiarise the students about the compatibility of stone chippings and bitumen to make a bitumen mix for use as a wearing layer in bituminous pavements.

### **Course Outcomes:**

Students will be able to

- Perform tests on aggregate sample for use in various component layers of flexible pavements and rigid pavements.

- Understand the test procedure and practically conduct the test and infer the applicability of the aggregate sample according the IRC recommendations.
- Assess the strength of the soil subgrade and design the pavement thickness that can be provided over the soil subgrade in the field.
- Perform various tests on the bitumen sample and infer its applicability in flexible pavement construction as a wearing coat material by comparing the test results with IRC specifications.
- Perform tests to identify the compatibility of the stone chipping and bitumen sample.

## **SYLLABUS**

**Testing of Aggregates:** Sieve Analysis test ; Impact Value test ; Aggregate Crushing value test ; Shape tests – Flakiness Index test, Elongation Index test, Angularity Number ; Los Angeles Abrasion test ; Specific gravity test ; Soundness test.

**Testing of Bituminous Material:** Penetration Value test; Viscosity test; Softening Point test; Ductility test; Flash and Fire Point test; Specific Gravity test.

**Testing on Soil Subgrade:** California Bearing Ratio (C.B.R) test.

**Testing on Bituminous Mixes:** Aggregate Stripping value test.

### **Reference Book**

Highway material testing by S.K. Khanna, C.E.G. Justo and A. Veeraragavan, Nem Chand & Brothers

## **CV 3209    SOFT SKILLS**

### **Course Objectives:**

- To develop skills to communicate clearly.
- To aid students in building interpersonal skills.
- To enhance team building and time management skills.
- To inculcate active listening and responding skills.

### **Course Outcomes:**

- Make use of techniques for self-awareness and self-development.
- Apply the conceptual understanding of communication into everyday practice.
- Understand the importance of teamwork and group discussions skills.

- Develop time management and stress management.

## SYLLABUS

**Introduction to Soft Skills:** Communication – Verbal and Non Verbal Communication - Personal grooming (Etiquette, Attitude, Body Language), Posture, Gestures, Facial Expressions, Eye Contact, Space Distancing, Presentation Skills, Public Speaking, Just a Minute (JAM) sessions, Adaptability.

**Goal Setting and Time Management:** Immediate, Short term, Long term, Smart Goals, Strategies to Achieve goals, Types of Time, Identifying Time Wasters, Time Management Skills, Stress Busters.

**Leadership and Team Management:** Qualities of a Good Leader, Team Dynamics, Leadership Styles, Decision Making, Problem Solving, Negotiation Skills.

**Group Discussions:** Purpose (Intellectual ability, Creativity, Approach to a problem, Tolerance), Group Behaviour, Analyzing Performance.

**Job Interviews:** Identifying job openings, Covering Letter and CVs / Resumes, Interview (Opening, Body-Answer Q, and Close-Ask Q), Telephone Interviews, Types of Questions.

### Reference Books:

1. Krannich, Caryl, and Krannich, Ronald L. Nail the Resume! Great Tips for Creating Dynamite Resumes. United States, Impact Publications, 2005.
2. Hasson, Gill. Brilliant Communication Skills. Great Britain: Pearson Education, 2012
3. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Education, 2001.
4. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.
5. Rizvi, Ashraf M. Effective Technical Communication: India, McGraw-Hill Education. 2010
6. Thorpe, Edgar & Showick Thorpe. Winning at Interviews. 2nd Edition. Delhi: Dorling Kindersley, 2006.

**B.Tech & B.Tech. +M.Tech  
IV Year - I Semester**

**CV4101 PROFESSIONAL ELECTIVE - III**

**CV 4102 PROFESSIONAL ELECTIVE – IV**

**CV 4103 PROFESSIONAL ELECTIVE – V**

**CV 4104 OPEN ELECTIVE –III**

**CV 4105 OPEN ELECTIVE –IV**

**CV 4106 HSS ELECTIVE**

**CV 4107 QUALITY EVALUATION OF CIVIL ENGINEERING  
STRUCTURES**

**Course Objectives:**

- To study various Non-destructive testing techniques to evaluate quality of concrete
- To impart knowledge regarding advanced quality evaluation techniques
- To understand various causes of degradation in steel structures
- To study different methods used to assess degree of field compaction
- To understand different methods of determining CBR of insitu soil
- To impart skills to check unevenness of pavements through various techniques

**Course Outcomes:**

At the end of the course student will be able to

- Evaluate homogeneity and strength of concrete using different NDT techniques
- Understand different techniques used to assess durability of concrete
- Select appropriate method to assess corrosion activity of steel
- Assess quality of compaction achieved in embankments and pavements
- Evaluate continuity and integrity of concrete piles
- Understand various methods used for quality evaluation of pavements

## **SYLLABUS**

**Introduction** – Necessity of Non-Destructive Evaluation and Structural Health Monitoring; Fundamental differences between NDE and SHM philosophies; Causes of degradation in concrete and steel structures; General methods of NDT of civil engineering structures according to Indian Standards; Exposure to different techniques: Rebound Hammer, Ultrasonic Pulse Velocity, Resistivity meter, Poroscope, Half-cell potential cell, Profometer (Cover meter)

**Evaluation of Field Compaction:** Degree of Compaction, Relative Density, Rapid Moisture Meter, Proctors Compaction Needle.

**Quality Evaluation of Casted Piles:** Pile Integrity Test

**Evaluation of Quality of Pavements:** Field CBR test, Dynamic Cone Penetrometer, Determination of Unevenness of Pavement by Benkelman Beam Method, Rebound Deflection of Flexible Pavements, Bitumen Extraction Test.

**B.Tech & B.Tech. +M.Tech    IV Year - II Semester**

**CV4201    PROJECT WORK**



## PROFESSIONAL ELECTIVE

### 1. HYDRAULIC AND IRRIGATION STRUCTURES

#### Course Objectives:

- To study modes of failure, stability analysis and design of gravity dam and earth dams.
- To study various types of spillways and their suitability, energy dissipation below spillways.
- To study seepage theories and their applications in the design of weirs on permeable foundations.
- To study functions, types and suitable locations for canal falls, canal regulators and cross drainage works.
- To study about component parts and their functions.

#### Course Outcomes:

At the end of the course the student will be able to:

- Analyze the stability analysis and design of gravity dam and an earth dam.
- Suggest a suitable spillway at a dam site and understand the criteria for design of stilling basin for energy dissipation under spillway.
- Understand the functions and suitable locations of canal outlets, canal falls, canal regulators and cross drainage works and design of weirs.
- Understand the functions of component parts of a hydroelectric power scheme.

### SYLLABUS

**Storage Works:** Classification of Dams, Factors Governing Selection of Types of Dam, Selection of Site, Preliminary Investigation.

**Gravity Dams:** Forces acting on a Gravity Dam, Stability Criteria, Modes of Failure – Elementary and Practical Profiles, Stability Analysis, Principal and Shear Stress – Construction Joints, Openings in Dams – Galleries, Foundation Treatment of Gravity Dam.

**Earth Dams:** Types, Foundation for Earth Dams, Design of Earth Dams, Causes for Failure of Earth Dams, Criteria for Safe Design, Phreatic Line, Seepage Analysis – Seepage Control Through Body and Foundation.

**Spillways:** Essential Requirements, Spillway Capacity, Components, Types of Spillways and Their Working, Design of Ogee Spillway, Energy Dissipation Below Spill Way, Scour Protection, Use of Hydraulic Jump as Energy Dissipater – Design of Stilling Basins – USBR and IS Standard Basins; Spillway Crest Gates – Different Types.

**Diversion Head Works:** Types, Location and Components, Effects of Construction of Weirs on Permeable Foundation, Bligh's, Lanes and Khosla's Theories, Method of Independent Variables, Design Principles of Weirs and Barrages, Design of Weirs on Permeable Foundations, Design of Vertical Drop Weir, and Silt Control Devices.

**Regulation Works:** Canal Falls – Definition, Necessity and Location, Classification of Falls, Design Principles of Syphon Well Drop, Notch Fall, Sarada Fall, Straight Glacis Fall; Offtake Alignment; Cross Regulator and Distributary Head Regulator – Design of Cross Regulator and Distributor Head Regulator.

**River Training Works:** River Training and its Objectives, Classification of River Training Works, Marginal Embankment, Guide Banks, Groynes, Cutoffs, Bank Pitching, Launching Aprons, Miscellaneous Types of River Training Works.

**Water Power Engineering:** Development of Hydro Power in India, Assessment of Available Power, Utilization Factor, Load Factor, Diversity Factor, Storage and Pondage; Types of Hydro Power Schemes; Components of Hydel Schemes – Fore Bay, Intake Structure, Trash Racks, Surge Tanks; Water Hammer Pressure, Substructure and Superstructure of Power House..

#### **Text Bookss**

1. Irrigation and Water Power Engineering by Punmia, B.C. and P.B.B. Lal, Laxmi Publications Pvt. Ltd.
2. Irrigation Water Resources and Water Power Engineering by Modi, P.N., Standard Book House.
3. Irrigation and Hydraulic Structures by Garg, S.K., Khanna Publishers.

#### **Reference Book**

1. Hand book of Applied Hydrology, Chow, V.T., McGraw-Hill Book Co. of a hydel project.

## **2. MATRIX METHODS OF STRUCTURAL ANALYSIS**

#### **Course Objectives:**

- Impart knowledge regarding matrix-based approach for linear elastic analysis of structures.
- Analyse beams by using Flexibility and Stiffness methods.
- Develop flexibility and stiffness matrices for 2-D frames.
- Determine deflections and forces in statically determinate and indeterminate structures using flexibility and stiffness methods.
- Analyse 2-D trusses by using flexibility and stiffness matrix methods.

### **Course Outcomes:**

At the end of the course the student will be able to:

- Understand basic concepts of matrix methods for analysing of structures.
- Develop flexibility and stiffness matrices for structural elements.
- Analyse various types of beams by using flexibility and Stiffness methods.
- Analyse 2-D trusses using flexibility and Stiffness methods.
- Analyse 2-D frames using flexibility and Stiffness methods.

## **SYLLABUS**

**Introduction to matrix methods:** Introduction, coordinate systems, displacement and force transformation matrices, element and structure stiffness matrices, element and structure flexibility matrices, equivalent joint loads, stiffness and flexibility approaches.

**Matrix methods for beams:** Analysis of beams, fixed and continuous beam by flexibility method. Analysis of beams, fixed and continuous beams by stiffness method.

**Matrix methods for plane truss problems:** Analysis of 2-D trusses by flexibility method. Analysis of 2-D trusses by stiffness method.

**Matrix methods for Plane Frames:** Analyse of 2-D frames by Flexibility matrix methods. Analysis of 2-D frames by stiffness matrix methods.

### **Text Books**

1. Matrix methods of Structural Analysis by G.S.Pandit and S.P.Gupta, Tata McGraw Hill Co..
2. Matrix Analysis of framed Structures by W Weaver and Gere, Van Nostrand Reinhold.

### **Reference Books**

1. Advanced Structural Analysis by Devdas Menon, Narosa Publishing House, 2009.
2. Matrix Analysis of Structures by Aslam Kassimali, Brooks/Cole Publishing Co., USA, 1999.
3. Analysis of Indeterminate Structures by C.K Wang, McGraw-Hill.

## **3. INTRODUCTION TO ROCK MECHANICS**

### **Course Objectives**

- To study the classification and properties of rock mass
- To illustrate the rock exploration techniques required during subsoil investigation

- To acknowledge the importance of identification of defects in rock mass
- To study laboratory and insitu methods for determining strength and deformation characteristics of rocks
- To understand different methods of improving properties of rock mass

### **Course Outcomes**

- Identify and classify the rocks based on their physical and mechanical properties
- Evaluate core recovery and RQD of rock mass
- Understand various methods for evaluating properties of intact rock and rock masses
- Select appropriate reinforcement technique for improving properties of rocks
- Understand the procedure of blasting in rocks

## **SYLLABUS**

**Introduction:** Geological Formation of Rocks, Structural Geology, Classification of Rocks, Defects in Rock, Physical, Mechanical Properties of Rocks, Exploration Techniques – RQD and RMR, Laboratory Tests for Shear Strength, Tensile Strength, Flexural Strength, Elastic Constants, Field Tests – Test for Deformability, Shear Tests and Strength Tests

**Improvement Techniques for Rock:** Grouting, Rock Bolting, Rock Reinforcement - Mechanism, Types of Reinforcement, Steps Involved in Installation

Foundations on Rock, Rock Blasting– Explosives, Selection Criteria for Explosives, Steps Involved in Blasting

### **Text Books**

1. Rock Mechanics for Engineers by B.P.Verma, Khanna Publishers

### **Reference Books**

1. Rock Characterization, Testing and Monitoring by E.T.Brown, Pergamon Press, London, U.K
2. Rock Mechanics on the Design of Structures in Rock by Oberti and Duval, W. L. John Wiley & Sons.
3. Rock Mass Classification Systems – A Practical Approach in Civil Engineering by B.Singh and R.K.Goel, Elsevier Publisher.

## 4. ADVANCED DESIGN OF STRUCTURES

### Course Objectives:

- To familiarise the students of with earth pressure theories and pressure theories and design of different types of retaining walls.
- To impart knowledge about the analysis and design of liquid retaining structure according to is code.
- To impart knowledge about the limit state design of plate girders used for long spans.
- To impart skills of analyzing and designing different types steel bridges subjected to different types of loads.
- To familiarize students with gantry girder and their design.

### Course Outcomes:

Students will be able to

- Understand earth pressure theories, as well as the design and detailing of various retaining walls;
- Analyse and design circular, rectangular, and staging water tanks.
- Proportionate section of plate girder and design of bolted and welded plate girders as per is 800-2007 and understand curtailment of flange plates and, connection of flange angles to web and flange angles to flange plates.
- Compute design loads on the bridges and design deck type or through type girder bridges and bearings.
- Analyse and design steel elevated circular, rectangular and pressed steel water tanks.
- Performs analysis and design of gantry girders.

**Retaining walls:** types of retaining walls, forces on retaining walls, rankine and coloumb earth pressure theories (c and  $\phi$  soils). Passive earth pressure, drainage of retaining walls. Stability requirements. Preliminary proportioning of cantilever retaining walls. Design of cantilever and counterfort retaining walls.

**Water tanks:** stress in concrete and steel in water tanks, modular ratio, impermeability requirements, tanks resting on ground and below ground of circular and rectangular shapes; elevated circular and rectangular tanks resting on maximum of 8 columns; design of staging of rectangular tanks. (Use of is – 3370 CODE)

Design of Reinforced concrete combined footings with and without Strap Beam.

**Plate girders (bolted and welded):** components of a plate girder, economical depth, proportioning of web and flanges, shear buckling resistance of web (simple post critical and

tension field methods), curtailment of flange plates, connection of flange angles to web and flange angles to flange plates.

**Web stiffeners:** design of bearing stiffeners. End panel design, design of intermediate stiffeners, connections.

**Bridges:** classification, loadings, deck type and through type bridges, plate girder bridges, design of stringers, cross girders, wind bracings.

**Gantry girders:** introduction - loading consideration – maximum load effect – selection of gantry girder – analysis and design of gantry girders.

**Reference Books:**

1. Limit state of design of reinforced concrete – p.c. Vergheese
2. Reinforced concrete limit state design – a.k. Jain.
3. Design of reinforced concrete structures – p. Dayaratnam
4. Design of steel structures by n. Subramanian, oxford university press.
5. Limit state design of steel structures – ramchandra and virendra gehlot, scientific publishers (india)
6. Limit state design of steel structures by s.k.duggal, mcgraw hilleducation private ltd.
7. Design of steel structures by k.s.sai ram, pearson education india.
8. Design of steel structures by limit state method as per is: 800-2007 – s.s. Bhavikatti, ik international publishing house, bangalore – 560 001.

## 5. HYDRAULIC MACHINES

**Course Objectives**

- To explain methods of dimensional analysis and the importance of their application to the field of fluid mechanics.
- To impart knowledge in the application of impulse momentum principle and angular momentum principle for jets impinging on vanes
- To impart knowledge of working principle, selection and designing of impulse and reaction turbines
- To explain various components and working principles of centrifugal pump and reciprocating pump. Also to teach the criteria of selection of the pumps.
- To explain governing of turbines and performance characteristics of pumps and turbines working under different conditions

## Course Outcomes

On completion of this course, the student will be able to

- Understand the dimensional criteria to carryout model studies on hydraulic systems such as rivers, hydraulic structures and harbours.
- Understand the principles of hydraulic machinery, their operation and performance.
- Select appropriate hydraulic turbines for given conditions and study their performance characteristics
- Understand the operation of pumps and study their characteristics

## SYLLABUS

Dimensional Analysis and Similitude: Fundamental Concepts of Dimensional Analysis – Importance of Dimensional Analysis & Model Study; Units and Dimensional Formulae for Various Engineering Quantities; Fourier Concept of Dimensional Homogeneity.

Methods of Arriving at Dimensionless Groups – Non-dimensional Parameters; Rayleigh’s Method; Buckingham  $\pi$  method – Buckingham modified method; Omitted and Superfluous variables.

Examples in Dimensional Analysis – Capillary Rise, Drag on Cylinder, Resistance of a Ship, Discharge over a Sharp Crested Weir, Fall Velocity of a Sphere, Head Characteristics of a Pump, Thrust on a Propeller,

Similarity and Similarity Laws – Concepts of Similarity – Geometric, Kinematic and Dynamic Similarities; Modeling Criteria; Similarity Laws – Important Dimensionless Numbers – Reynolds Number, Froude Number, Mach Number, Euler Number, Weber Number.

Application of Similarity Laws to Practical Problems – Bodies Completely Submerged in Fluids, Bodies Subjected to Gravity and Viscous Forces, River Models – Manning’s Law; Distorted Models – Depth Distortion and Slope Distortion; Problems Related to Modeling of Spillways, Ships, Pumps and Turbines.

Impact of Jets: Force Exerted by Fluid Jet on Stationary and Moving Flat and Curved Vanes, Torque and Work Done by Series of Moving Vanes.

Hydraulic Machines– Turbines: Introduction and Classification of Turbines – Function of Prime Movers and Pumps, Hydraulic Turbines, Classification Based on Head, Discharge, Hydraulic Action – Impulse and Reaction Turbines, Differences Between Impulse and Reaction Turbines; Choice of Type of Turbine – Specific Speed.

Working of Impulse Turbines and Design Principles – Components and Working Principles of a Pelton Turbine – Work Done; Hydraulic and overall Efficiencies; Design of Pelton Turbine – Working Proportions; Governing Mechanism for a Pelton Turbine.

Working of Reaction Turbines and Design Principles – Components and Working Principles of a Francis Turbine – Work Done; Hydraulic and overall Efficiencies; Design of Francis Turbine– Working Proportions; Governing Mechanism for a Francis Turbine. Draft Tube Theory –

Functions and Types of Draft Tubes in Reaction Turbines, Efficiency of Draft Tube; Kaplan Turbine and Working Proportions of Kaplan Turbine.

Performance and Characteristics of Turbines: Unit Quantities, Specific Speed and its Importance; Model Relationships; Operating Characteristic Curves; Cavitation Problem in Turbines – Thoma's Cavitation Factor.

Hydraulic Machines – Centrifugal Pumps Functions of a Pump – Types of Pumps – Selection Criterion – Rotodynamic and Positive Displacement Pumps – Comparison between Centrifugal & Reciprocating Pumps.

Centrifugal Pumps – Components & Working principles of Centrifugal Pumps; Classification of Centrifugal Pumps – Impellers based on Shape and Type of Casing, Pump with Volute Casing, Pump with Vortex Chamber & Pump with Guide vanes, Closed, Semi-closed & Open Impellers, Axial, Radial & Mixed Flow Impellers; Working Head and Number of Stages, Single & Double Suction. Work done by Centrifugal Pumps – Pressure Change in a Pump, Manometric and Static Head – Velocity triangles – Effect of Vane Shape; Pump Losses and Efficiency – Pressure Rise in the Impeller – Minimum Starting Speed of pump – Multistage Pumps; Pumps in Parallel and Series; Cavitation – Limitation of Suction Lift, NPSH and its importance in Selection of Pumps. Performance Characteristics of Pumps – Similarity Relations and Specific speed of Pumps – Dimensionless characteristics – Constant Efficiency Curves of Centrifugal Pumps.

Hydraulic Machines – Reciprocating Pump & Hydraulic Ram: Reciprocating Pumps – Fundamental concepts, Component Parts and Working principle of Single Acting and Double Acting Reciprocating Pumps – Discharge Coefficient, Volumetric Efficiency and Slip; Work done by Reciprocating pumps – Work Done and Power Input – Indicator Diagram – Effect of Acceleration and Friction on Indicator Diagram – Maximum Speed of Rotation of Crank; Air Vessels and their principles – Modified Indicator Diagram in the presence of Air Vessels, Work Saved due to Presence of Air Vessel, Flow into and from Air Vessel.

#### Text Books

1. Fluid Mechanics and Hydraulic Machinery by P.N. Modi and S.M. Seth, Standard Book House.
2. Fluid Mechanics by Jain, A.K., Khanna Publishers.

#### Reference Books

1. Engineering Fluid Mechanics by K.L. Kumar, S. Chand & Co. Ltd.
2. Hydraulic Machines by Jagadish Lal, Metropolitan Book Company.



## 6. GEO-ENVIRONMENTAL ENGINEERING

### Course Objectives:

- To impart knowledge about solid wastes and MSW.
- To understand about soil pollution and remedies.
- To inculcate the ideas about waste containment and waste disposal facilities.
- To analyse the reasons for soil erosion and its effect on human activities.
- To describe the preventive measures including structure to control soil erosion and consequences.

### Course Outcomes:

On completion of this course, the student will be able to

- Understanding characterization of wastes provides various disposal and remediation measures.
- Creation of knowledge about landfill and its components for waste containment.
- Analysis of pollutants and their characterization helps in study of soil pollution and to propose various environment protective measures.
- Deriving knowledge about types of erosions and their controlling measures extends to various erosional features related to geological and geomorphological concern

### SYLLABUS

Wastes: Source, Production and Classification of Wastes, Soil Pollution Processes, Waste Characterization, Physical Characterization, Problems due to Improper Disposal of Wastes, Waste Management Strategies.

Soil Pollution, Sources of Soil Pollution, Control of Soil Pollution.

Waste Disposal Facilities such as Landfills, Configuration or Types of Landfill, Components of Landfill, Layout of a Landfill Site, Stages of Decomposition of Waste in a Landfill, Landfill Planning and Design. Barrier Systems – Active Systems, Passive Systems, Vertical Barriers and their Types, Bottom Barriers, Reuse of Waste Materials, Contaminated Site Remediation.

### Text Books

1. Geoenvironmental Engineering – Principles and Applications by Reddi, L. N., and Inyang, H. F., Marcel Dekker.

### Reference Books

1. Geotechnical Practice for Waste Disposal by Daniel, D. E., Chapman and Hall, London.

2. Clay Barrier Systems for Waste Disposal Facilities by Rowe, R. K., Quigley, R. M. and Booker, J.R., E & FN Spon, London.

## 7. REMOTE SENSING AND GIS APPLICATIONS

### Course Objectives:

- To introduce the basic concept and principles of Remote Sensing
- To illustrate solar energy interactions with atmosphere and with earth surface features
- To Know about different types of satellite and sensors.
- To Learn image analysis and apply for interpretation of satellite images
- To understand data types, data inputs and data analysis in GIS and Learning about map projection and coordinate system.
- To develop knowledge on RS and GIS applications in civil engineering.

### Course Outcomes:

After completing this course, the student will have acquired the ability on the following.

- Understand the principle of remote sensing, develop ability to comprehend the energy interactions with atmosphere and earth surface features, spectral properties of various natural and cultural features.
- Understand types of satellite images and their characteristics and develop ability to choose appropriate sensor products for various remote sensing applications.
- Ability to perform image analysis and image interpretation.
- Understand spatial and non-spatial data features in GIS and know vector and raster data representation in GIS.
- Understand the map projections and coordinates systems and able to create thematic layers.
- Understand the integration of Remote Sensing and GIS and apply the knowledge to work in various application fields through spatial analysis.

## SYLLABUS

**Remote Sensing:** Introduction, Basic components of remote sensing, electromagnetic radiation, electromagnetic spectrum, interaction with atmosphere, energy interaction with the earth surfaces, Sensors- types and characteristics, passive sensor, active sensor, platforms-airborne remote sensing, space borne remote sensing, data pre-processing, Important Remote Sensing Programme.

**Geographic Information System:** Introduction, key components, spatial data, raster data models, vector data models, raster versus vector, data input methods and editing, non-spatial data, map projections.

Image analysis: Introduction, elements of visual interpretations, digital image processing- digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, image preprocessing, image rectification, image enhancement, image classification, supervised classification, unsupervised classification.

**GIS analysis:** Introduction, digital elevation models, RS and GIS data integration, overlay function-vector overlay operations, raster overlay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, some neighbourhood operations.

**RS and GIS applications in Civil Engineering:** Land cover and land use, urban applications, Hydrological studies, runoff modeling, flood zone delineation and mapping, groundwater prospects and recharge, reservoir storage estimation, water management, irrigation planning, drought monitoring, environmental impact assessment and other watershed studies.

#### **Text Books**

1. Remote Sensing And Image Interpretation By Thomas M. Lillesand And Ralph W. Kiefer, John Wiley And Sons Inc.
2. Gis By Kang Tsung Chang, Tmh Publications & Co.

#### **Reference Books**

1. Remote Sensing And Its Applications By Dr George Joseph.
2. Concepts & Techniques Of Gis By C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
3. Principles Of Geographical Information Systems – Peter A Burragh And Rachael A. Mc Donnell, Oxford Publishers 2004.

## **8. EARTH RETAINING STRUCTURES**

#### **Course Objectives:**

- To recognize the need for soil retention systems in granular and cohesive soils
- To deepen the understanding of the concepts related to earth pressures and their distribution through classical theories.
- To differentiate between the lateral pressure distribution in braced cuts and retaining walls
- To impart skills to analyse and design retaining walls

- To analyse and design sheet pile walls in granular and cohesive soils

### **Course Outcomes:**

At the end of the course student will be able to

- Compute the earth pressures acting behind the retaining structures, from different methods.
- Carry out analysis and design of the retaining walls for a given height of backfill
- Suggest the most appropriate type of retaining system to be adopted for a given site conditions.
- Develop earth pressure envelopes for design of braced cuts and check their stability
- Perform design of anchored bulk heads

## **SYLLABUS**

**Earth Pressure:** Basic Concepts, Rankine and Coulomb Earth Pressure Theories, Determination of Active and Passive Pressures: Culmann's Graphical Method, Logarithmic Spiral Methods, Friction Circle Method. Consideration of Surcharge, Seepage, Earthquake, Wave Effect, Stratification, Type of Backfill, Wall Friction and Adhesion.

**Retaining Structures:** Uses, Types, Stability and Design Principles of Retaining Walls, Backfill Drainage, Settlement and Tilting. Sheet Pile Walls: Types, Design of Cantilever Sheet Pile Walls in Granular and Cohesive Soils; Design of Anchored Sheet Pile Walls by Free and Fixed Earth Support Methods, Rowe's Theory of Moment Reduction, Design of Anchors.

**Braced Excavations:** Types of Sheet piling and Bracing Systems, Lateral Earth Pressure on Sheet piling in Sand and Clay, Design Components of Braced Cuts. Cellular Cofferdams: Types – Diaphragm and Circular Type, Design by TVA Method. Stability of Cellular Cofferdams, Cellular Cofferdams in Rocks and Soils.

### **Text Books**

1. Foundation design by W. C. Teng, Prentice Hall

### **Reference Books**

1. Basic and Applied Soil Mechanics by Gopal Rajan and A.S.R. Rao, New Age International Publishers.
2. Soil Mechanics in Engineering Practice by K.Terzaghi and R.B.Peck, John Wiley & Sons.
3. Foundation Analysis and Design by J. E. Bowles, Mc Graw-Hill Publishing Co.

## 9. REPAIR AND RETROFITTING OF STRUCTURES

### Course Objectives:

- To learn various distress and damages to concrete and masonry structures
- To understand the importance of maintenance of structures
- To study the various types and properties of repair materials
- To assess the damage to structures using various tests
- To learn the importance and methods of substrate preparation
- To learn various repair techniques of damaged structures, corroded structures

### Course Outcomes:

At the end of the course student will be able to

- Understand the properties of fresh and hardened concrete.
- Know the strategies of maintenance and repair.
- Get an idea of repair techniques.
- Understand the properties of repair materials
- Understand the retrofitting strategies and techniques

**Materials:** Construction chemicals, Mineral admixtures, Composites, Fibre reinforced concrete, High performance concrete, polymer-impregnated concrete.

**Techniques to test the existing strengths:** Destructive and non destructive tests on concrete.

**Repairs of Multistory structures:** Cracks in concrete, possible damages to the structural element-beams, slab, Column, Footings, etc., Repairing techniques like Jacketing, Grouting, External prestressing, Use of chemical admixtures, Repairs to the fire damaged structures.

**Foundation problems:** Settlement of shallow foundations – repairs, sinking of piles, wells – repairs.

**Corrosion of Reinforcement:** Preventive measures – coatings –use of SBR modified cementitious mortar, Epoxy resin mortar, Acrylic modified cementitious mortar, flowing concrete.

### Reference Books

1. “Deterioration, Maintenance and Repair of Structures” by Johnson, McGraw Hill.
2. “Concrete Structures: Repairs, water proofing and protection” by Philip H. Perkins, Applied sciences publications Ltd., London, pp.302.
3. “Durability of concrete structure: Investigation, Repair, Protection” Edited by Geoffmang., E. & FN SPON, An imprint of Chapman & Hall, pp.270.

4. “Deterioration, maintenance and Repair of structures” by Johnson, McGraw Hill, pp.375

## 10.RAILWAYS AND HARBOUR ENGINEERING

### Course Objectives:

- To impart knowledge about the different modes of transportation like railways and harbours.
- To impart knowledge about the components of a railway track, its geometric design elements, rail fixtures and fastening etc.
- To familiarise the students about harbours and ports.
- To impart knowledge about the harbour phenomena like waves, tides, sediment transport, littoral drift etc.
- To familiarise the students about the components of harbours and ports like breakwaters etc.

### Course Outcomes:

Students will be able to

- Understand and design the railway section incorporating geometric design elements like superelevation, analyzing safe speeds on the sections of railway track, transitional curves etc.
- Provide appropriate signals at station yards thereby reducing accidents.
- Design the features of a turnout like points and crossing.
- Design the facilities to be provided inside a harbour or port for safe navigation.
- Design the different navigational aids to be provided while navigation and also fixed navigational structures like lighthouses.

**Railway Engineering I:** Comparison of Railway and Highway transportation; Advantages of Railways; Classification of Indian Railways; Railway track components and their functions; Capacity of track; Gauges in Railway Track; Railway track cross-sections.

**Railway Engineering II:** Functions of Rails; Rail failures; Rail joints and Welding of rails; Creep of rails; Rail fixtures and fastenings; Sleepers; Ballast.  
Geometric Design of track - Gradient, Super elevation, Curves, Widening of gauge on Curves.

**Railway Engineering III:** Points and Crossings - Turnout, Switches, Crossing and its types; Track junctions; Stations and yards; Signaling and Control system; Interlocking; track drainage and maintenance.

**Harbour Engineering I:** Types of water Transportation; Advantages and disadvantages of water transportation; Harbour Classification; Harbour site investigation and site analysis; Harbour size and depth.

**Harbour Engineering II:** Natural phenomenon- Tides, Wind, Waves, Currents, Littoral drift. Harbour works- Break waters and their types; Harbour Components- Jetty, Piers, Wharves, Off-shore moorings.

Navigational Aids - Fixed navigational structures, Floating navigational aids.

### **Text Bookss**

1. Railway Engineering by S.C. Saxena and S. Arora, Dhanpat Rai Publications Pvt. Ltd.
2. Dock & Harbour by .S.P.Bindra

### **Reference Books.**

1. Railway Engineering by Rangwala.
2. Dock & Harbour by Birdie.

## **11.ENVIRONMENTAL IMPACT ASSESMENT**

### **Course Objectives:**

- To familiarise with EIA methodologies
- To impart knowledge on EIA case studies
- To input skills on prediction and assessment of air and noise environment
- To input skills for prediction and assessment of water and soil environment
- To familiarise with cultural and socio economic environment

### **Course Outcomes:**

the student will be able to

- Understand the concept and methodologies of EIA
- Understand the procedure for environmental clearance
- Discuss the basic information on environmental attributes like air, water and noise
- Discuss the standards, impact assessment and mitigation
- Discuss the socio economic attribute, resettlement and rehabilitation issues

## **SYLLABUS**

**Concept of Environment** – Definition of EIA and EIS – Elements of EIA – Guidelines for the Preparation of EIS – Governmental Policies for Environmental Protection.

**Environmental Setting** – Environmental Attributes – Air, Water, Soil, Noise, Ecological, Social, Economical, Cultural, Human and Aesthetic Aspects – Environmental Indices.

**Methodology for the Identification of Impacts** – Criteria for the Selection of Methods – Methodologies – Adhoc, Checklist, Overlaying, Matrix and Network Methods.

Prediction and Assessment of Impacts on – Air, Water, Soil, Noise, Ecological, Social, Economical, Cultural, Human Environments and Aesthetic Aspects.

**Review of Environmental Impact Statement** – Cost Benefit Analysis – Measures for Environmental Impact Mitigation and Control – Case Studies.

### **Text Books**

1. Environmental Impact Assessment by Larry W. Canter. McGraw-Hill Co.
2. Environmental Impact Assessment Methodologies by Y Anjaneyulu, and Valli Manikkam,, BSP Books PVT Ltd.

### **Reference Books**

1. Environmental Impact Assessment by R.K.Jain, L.V.Urban, G.S.Stacey and H.E. Balbach, McGraw-Hill Co.

## **12.BRIDGE ENGINEERING**

### **Course Objectives:**

- To equip the students with a thorough understanding of the behavior and design of bridges.
- To impart knowledge about components, classifications and choice of bridge type along with the investigation for bridges in detail.
- To give a clear idea of various IRC standard specifications for R.C.C road bridges.
- To develop skills to analyse and design short and medium span bridges using existing codes of practice, taking into account the structural strength, service life, and durability.
- To familiarise the design and Stability analysis of foundation for bridges.

### **SYLLABUS**

**Concrete Bridges:** Introduction-Types of Bridges-Economic span length, Importance of site investigation in Bridge design -Types of loading-Dead load-Live load(IRC Standards)-Impact Effect-Centrifugal force-wind loads-Lateral loads-Longitudinal forces-Seismic loads-Frictional resistance of expansion bearings-Secondary Stresses-Temperature Effect-Erection Forces and effects-Width of roadway and footway-General Design Requirements.



**Box culvert:** General aspects, Design loads, Design of Box culvert subjected to IRC loading.

**Solid slab Bridges:** Introduction-Method of Analysis and Design of solid slab bridge subjected to IRC loading.

**Beam & Slab Bridge (T-Beam Girder Bridge):** General features – Design of interior panel of slab – Pigeaud’s method – Analysis and design of T-beam longitudinal girder subjected to IRC loading – Analysis and design of Cross Girder.

**Piers & Abutments:** General features – Bed Block – Materials for Piers & Abutments, Types of piers – Forces acting on piers – Design and Stability analysis of piers – General features of Abutments – forces acting on abutments – Design and Stability analysis of abutments .

#### **Course Outcomes:**

At the end of the course, the student will be able to

- Discuss the IRC standard live loads and design the deck slab type bridges.
- Understands the structural responses to different kinds of loads.
- Perform the Analysis of box culverts for the given loading and detail the box culverts.
- Analyse and design solid slab bridge.
- Design and detail of T-Beam bridges.
- Design and check the stability of piers and abutments.

#### **Text Bookss**

1. “Essentials of Bridge Engineering”, D. Johnson Victor, Oxford University Press.
2. “Design of Bridges”, N.Krishna Raju, Oxford & IBH Publishing Co.Pvt.Ltd, New Delhi.

## **13.INDUSTRIAL WASTE TREATMENT**

#### **Course Objectives:**

- Acquire knowledge on characteristics of waste water from various sources and its primary treatment.
- Impart knowledge about principles of biological waste treatment.
- Design the processes of different biological treatment units.
- Familiarize with the various principles in industrial waste treatment.
- Understand the manufacturing processes, treatment of wastes and disposal methods of various industries.

**Course Outcomes:**

At the end of the course student will be able to

- Understand characteristics of waste water and primary treatment process of waste water.
- Discuss the different principles of biological waste treatment.
- Understand the design processes of different biological treatment units.
- Understand the various principles involved in treatment of industrial wastes.
- Summarize the manufacturing processes, treatment of wastes and disposal methods of various industries.

**SYLLABUS**

Characteristics of waste water of specific industries, characteristics of treatment plant effluents, Effect of waste water on self-purification capacity of streams, Primary treatment of waste water.

Principles of biological waste treatment; Microbiological growth rate kinetic equations, sludge production, oxygen requirements, continuous flow treatment models. Aerobic treatment studies in continuous and semi-continuous reactors. Anaerobic treatment, studies, Nitrogen and Phosphorus removal.

Biological treatment facilities : Process designs of the following units w.r.t. Industrial Wastes; Activated sludge process; trickling filter; sludge digestion units; Aerated lagoons; Stabilization ponds (oxidation ponds); oxidation ditches (Paveer ditches); Rotating Biological contactor; Anaerobic filter.

Principles of Industrial waste Treatment: Waste reduction pretreatment of wastes, collection and segregation of wastes, reduction in volume and strength neutralization; equalization; proportioning.

Manufacturing processes, flowsheets; Characteristics and treatment of wastes and disposal methods of the following industries – Sugar, Dairy, Distillery, Paper, Tannery, Textile, Sheet, Fertilizer, Oil refinery and Petrochemicals.

**Reference Books**

- 1) Waste Water Treatment by M.N. Rao and A. K. Datta

## 14. TRAFFIC ENGINEERING AND MANAGEMENT

### Course Objective:

- To impart knowledge about the traffic characteristics, traffic studies and analysis.
- To design the roadway facilities to achieve an efficient, free and rapid flow of traffic.
- To impart knowledge about traffic studies such as traffic volume studies, speed studies, accident studies etc.
- To explain the functions of traffic control devices and the design of intersections.
- To explain the different management measures to be implemented on roads to improve the capacity.

### Course Outcomes:

Students will be able to

- Design the road way facilities with signs, signals, markings and islands so as to achieve efficient flow of traffic.
- Acquire knowledge about different traffic studies such as speed studies, parking studies, accident studies etc.
- Gain knowledge to design the road way facilities efficiently for future traffic in a planned manner.
- Design the traffic signals efficiently to have a continuous and orderly flow of traffic with least delays.
- Implement traffic management strategies such as one-way street, staggering of work hours etc. to minimize congestion on roads with higher traffic intensity.

### SYLLABUS

Traffic Engineering: Introduction, Importance of Traffic Engineering under Indian conditions, Traffic characteristics, The Road user and the vehicle. Traffic Surveys: Speed, Journey Time & Delay Surveys, methods of measuring Spot speeds, methods of measurement of Running Speed and Journey Speed, moving observer method, Traffic volume studies – Types of Counts, Automatic devices, Presentation of traffic volume study data.

Origin & Destination Survey – Need for O – D surveys, Survey methods, Presentation of Results, Parking Surveys – Types of Parking surveys, Parking Space Inventory, Cordon Count, Questionnaire type parking usage Survey – Design of parking facility. Analysis and Interpretations of Traffic Studies.

Statistical methods for Traffic engineering - Mean, Standard Deviation and Variance. Traffic flow characteristics, Traffic Capacity studies – factors affecting practical capacity, Design

Capacity and Level of Service, Passenger Car Unit. Accident Studies – Accident studies and records, Accident investigations, Measures for reduction in accident rates, Traffic Safety.

Relationship between Speed, Travel time, Volume, Density and Capacity. Traffic Operations – Traffic regulation, Traffic Control Devices, Intersections – Intersection At Grade – Channelized and Unchannelized intersections, Rotary intersections, Grade – separated Intersections, Grade – separated structures.

Traffic Management – Transportation system Management, Travel Demand Management Techniques, Traffic management measures.

**Reference Books:**

1. Highway Engineering By S.K. Khanna & C.E.G. Justo
2. Traffic Engineering and Transport Planning By L.R. Kadiyali.

## **15.FINITE ELEMENT METHOD OF ANALYSIS**

**Course Objectives:**

- To familiarise with matrix methods.
- To introduce importance and applications of Finite Element Method (FEM).
- To impart knowledge of different mathematical Techniques used in FEM analysis.
- To implement the basics of FEM to relate stresses and strains.
- To learn the theory and characteristics of finite elements that represent engineering structures.

**Course Outcomes:**

At the end of the course student will be able to

- Analyse the response of structures by matrix methods.
- Understands the concepts behind formulation methods in FEM.
- Understands different mathematical Techniques used in FEM analysis.
- Develop element characteristic equation and generation of global equation of elements.
- Able to apply suitable boundary conditions to a global equation to find displacements, stress and strains induced

### **SYLLABUS**

Matrix Methods of Analysis – Introduction, Analysis of Beams and Portal Frames (One Bay, One Storey Two Bay, Two Storey) by Stiffness Method and Flexibility Method.

Introduction: A Brief History of F.E.M, Need of the Method, Applications of FEM, Review of Basic Principles of Solid Mechanics, Basic Equation in Elasticity Equations of Equilibrium, Constitutive Relationship, Concept of Plane Stress, Plain Strain, Concept of Axi-Symmetric Elements. Concept of Energy Principles and Methods.

Basic Theory Relating to the Formulation of the Finite Element Method, Element Shapes, Nodes, Nodal Degree of Freedom, Node Numbering, Coordinate System (Local and Global), Convergence Requirements, Compatibility Requirement, Geometric Invariance.

Finite Element Analysis of Single Bar Element (One-Dimensional Problem) – Shape Functions, Derivation of Stiffness Matrix, Stress-Strain Relations – All with Reference to Bar Element and Trusses under Axial Forces.

### **Text Books**

1. Structural Analysis – A Matrix Approach by G.S.Pandit and S.P.Gupta, Tata McGraw-Hill Publishing Co. Ltd.
2. Introduction to the Finite Element Method by C.S.Desai and J.F.Abel, Van Nostrand.
3. Finite Element Analysis by C.S.Krishnamoorthy, Tata McGraw-Hill Publishing Co. Ltd.

### **Reference Books**

1. Introduction to Finite Elements in Engineering by Tirupathi R. Chandrupatla, Ashok D.Belegundu, Prentice-Hall of India Private Limited.
2. Finite Element Analysis by S.S.Bhavikatti, New Age International Publishers.
3. Basic Structural Analysis by C.S. Reddy, Tata McGraw-Hill, New Delhi.
4. Finite Element Methods for Engineers by Reger, T. Fenner, The Macmillan Ltd., London

## **OPEN ELECTIVE**

### **1. SANITARY ENGINEERING**

#### **Course Objectives:**

- To familiarize the concept of sanitation and Estimation of Sewage Flow.
- To impart knowledge on design of sewers and hydraulics of sewers.
- To expose the necessity of sewage characteristics by physical, chemical and biological examinations.
- To create knowledge on BOD, COD and treatment of sewage water.
- To input knowledge on filters and design of filters.

- To make acquainted with the principles and design of sludge treatment.

**Course Outcomes:**

The students will be able to

- Understand the necessity of sanitation and estimate the sewage flow in drainages.
- Design the sewers and also appurtenances in sewerage.
- Analyze the physical, chemical and biological characteristics of sewage water.
- Evaluate the content of bod, cod and process involving in the treatment of sewage water.
- Design sludge treatment.

**SYLLABUS**

**Introduction to sanitation** – systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage – fluctuations – types of sewers – Hydraulics of sewers and storm drains– design of sewers – materials for sewers- appurtenances in sewerage – cleaning and ventilation of sewers—safety of sewer workers.

**Storm sewers- design:** Pumping of wastewater – Pumping stations – location – components parts– types of pumps and their suitability with regard to wastewaters. House Plumbing: plumbing systems of drainage-sanitary fittings and other accessories– single stack system- one pipe and two pipe systems – Design of building drainage.

**Bacteriology of sewage:** Sewage characteristics – Physical, Chemical and Biological Examination– decomposition- cycles of decomposition— Sampling and analysis of wastewater – BOD-COD-Treatment of sewage - Primary treatment: Screens-grit chambers – grease traps – floatation – sedimentation – design of primary and pretreatment units.

**Secondary treatment:** Aerobic and anaerobic treatment process-comparison. Suspended growth process: Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, miscellaneous methods, Oxidation ponds, Oxidation ditches, Aerated Lagoons.

**Attached Growth Process:** Trickling Filters – mechanism of impurities removal- classification– filter problems – design and operation-recirculation. RBCs, Fluidized bed reactors, sewage disposal methods.

**Anaerobic Processes:** Septic Tanks and Imhoff tanks-Principles and Design-sludge treatment and disposal-Fundamentals of UASB. Biosolids (Sludge): Characteristics- thickening – digestion,drying and sludge disposal.

### **Text Books**

1. Wastewater Engineering Treatment and Reuse by Metcalf & Eddy, Tata McGraw-Hill edition.
2. Environmental Engineering by Peavy, H.S., Rowe, D.R., and Tchobanoglous, G. McGraw-Hill international edition
3. Environmental Engineering. II: Sewage Disposal and Air Pollution Engineering, Khanna Publishers.

### **Reference Books**

1. Environmental Engineering –II: Sewage disposal and Air Pollution Engineering, by S.K.Garg, Khanna Publishers
2. Water Supply and Sanitary Engineering by G.S.Birdie and J.S.Birdie, Dhanpat Rai Publishing Company.
3. Water Supply Engineering by P.N.Modi, Standard Book House.
4. Water Supply Engineering by B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications (P) Ltd.

## **2. WATERSHED MANAGEMENT**

### **Course Objectives:**

- To give an overview of watershed management and principles of WSM.
- To impart knowledge on water resources and conjunction use of ground water and surface water to meet water demand.
- To impart knowledge on river basin watershed management and ground water management.
- To expose students about social aspects of WSM such as public aspects participation and integrated development.
- To emphasis on conservation of water through recycle and reuse of waste water, water harvesting.
- To explain the interference of integrated watershed management for sustainable development.
- To expose students to applications of RS and GIS for watershed management.

### **Course Outcomes:**

At the end of the course the student will be able to:

- Plan for sustainable development by proper use of all available water resources of a watershed for optimum production with minimum hazards to natural resources.
- Determine the various solutions to meet the water demand.
- Implement damage mitigation measures to control soil erosion.
- Adopt appropriate techniques or methods for water harvesting.

- Knowledge on determining effective watershed modeling.

## **SYLLABUS**

**Principles of Watershed Management:** Basics concepts, Hydrology and water availability, Surface water, Groundwater, Conjunctive use, Human influences in the water resources system, Water demand, Integrated water resources system

River basins Watershed Management Practices in Arid and Semi-arid Regions, Watershed management through wells, Management of water supply - Case studies, short term and long term strategic planning

**Conservation of Water:** Perspective on recycle and reuse, Waste water reclamation

**Social Aspects of Watershed Management:** Community participation, Private sector participation, Institutional issues, Socio-economy, Integrated development, Water legislation and implementations, Case studies

**Sustainable Watershed Approach:** Sustainable integrated watershed management, natural resources management, agricultural practices, integrated farming, Soil erosion and conservation

**Water Harvesting:** Rainwater management - conservation, storage and effective utilization of rainwater, Structures for rainwater harvesting, roof catchment system, check dams, aquifer storage

Applications of Geographical Information System and Remote Sensing in Watershed Management, Role of Decision Support System in Watershed Management.

### **Text Books:**

1. Murthy, J.V.S., Watershed Management in India, Wiley Eastern, New Delhi, 1994.

### **Reference Books:**

1. Murty, J.V.S., Watershed Management, New Age Intl., New Delhi 1998.
2. Allam, G.I.Y., Decision Support System for Integrated Watershed Management, Colorado State University, 1994.
3. Vir Singh, R., Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.
4. American Society of Civil Engineers, Watershed Management, American Soc. of Civil Engineers, New York, 1975.



### 3. ELEMENTS OF EARTHQUAKE ENGINEERING

#### Course Objective:

- To give the foundations of many basic engineering principles connected to earthquake engineering.
- To introduce philosophy of seismic design with emphasis on strength, stiffness and ductility effects.
- To provide hands-on experience with the application of engineering concepts in the field of earthquake engineering.
- To apply scientific and technological principles of building planning, analysis, and design in accordance with earthquake design philosophy.
- To train the students to analyze earthquake characteristics and associated effects on structures.

#### Course Outcomes

Upon completion of this course Students will

- Acquires knowledge about relevant concepts of structural dynamics for single-degree-of-freedom and multiple-degree-of-freedom systems.
- Identifies key elements, causes of earthquakes, different seismic zones and differentiate between intensity and magnitude of earthquake.
- Understands the characteristics of response spectrum and evaluates structural response.
- Define the basic concepts for the design and evaluation of seismic performance of buildings

### SYLLABUS

**One Degree Systems:** Undamped systems, various forcing functions damped systems, Response to pulsating force, Support motion. Lumped Mass Multidegree System: Direct determination of natural frequencies, Characteristic shapes, and multistory rigid frames subjected to lateral loads, damping in multi degree systems.

**Earthquakes,** Epicenter, Hypocenter and earthquake waves, Measurement of ground motion, Seismic regions, Intensity and Isoleismals of an earthquake, Magnitude and energy of an earthquake, Consequences of earthquakes, Seismic zoning.

**Earthquake Response of Linear Systems:** Earthquake excitation, Equation of motion, Response quantities, Response history, Response spectrum concept, Deformation, Pseudo-velocity, and Pseudo-acceleration, Response spectra, Peak structural response from the response spectrum, Response spectrum characteristics

**Earthquake analysis of Multistory buildings:** By seismic coefficient method and Response spectrum method, Base shear, Fundamental period of buildings, Distribution of forces along the height

**Text Books**

1. Dynamics of Structures, Theory and Applications to Earthquake Engineering by Anil K. Chopra, Prentice Hall of India.
2. Elements of Earthquake Engineering” by Jaikrishna and Chandrasekharan, Saritha Prakasham, Meerut.

**Reference Books**

1. Earthquake resistant design of structures” by S.K.Duggal, Oxford University Press.
2. Earthquake resistant design of structures” by Pankaj Agarwal and Manish Shrikhande, Prentice Hall of India Pvt. Ltd.

## **4. PRESTRESSED CONCRETE STRUCTURES**

**Course Objectives:**

- To familiarise with different methods of Prestressing and Pretensioning and their practical applications.
- To evaluate the short-term and long-term losses in prestressing and design prestressed structures considering these losses.
- To learn how to analyze and design flexural members under service and ultimate loads.
- To learn how to design structural elements for shear, torsion, anchorage and end block.
- To discuss and appraise the recent advances in the prestressed concrete technology including the use of advanced materials and application of new technologies.

**Course Outcomes:**

On completion of this course, the student will be able to

- Understand the basic theories and the fundamental behaviour of prestressed concrete.
- Ability to apply the fundamental knowledge to the solution of practical problems.
- Asses the combined stresses induced by prestress and applied loads using basic concepts of analysis, equivalent load method and load balancing approach.
- Analyse uncracked and cracked prestressed concrete sections.

## **SYLLABUS**

Introduction, Basic Concepts of Prestressing, Need for High Strength Steel and Concrete, Advantages of Prestressed Concrete; Materials for Prestressed Concrete, High Strength Concrete and High Strength Steel. Prestressing Systems (1) Freyssinet System (2) Gifford Udall (3) Magnel-Blatan System, Tensioning Devices, Anchoring Devices. (D) Pretensioning and Post Tensioning

Prestressing Losses, Elastic Shortening, Loss due to Shrinkage, Loss due to Creep, Loss due to Friction, Loss due to Curvature etc.; I.S. Code Provisions

Analysis of Prestressed Members, Assumptions, Pressure or Thrust Line; Concept of Load Balancing, Cable Profile, Kern Distance, Stress in Tendons as Per IS 1343, Cracking Moment. Deflection of Prestressed Concrete Beams

Limit State Design of Flexural Members, Stresses, I.S. Code Provisions, Design of Symmetrical Beams, Design of Prestressed Concrete Poles, Design for Shear, I.S. Code Provisions.

Transfer of Prestress (Pretensioned Members), Transmission Length, Bond Stress, Transverse Tensile Stress, End Zone Reinforcement, Flexural Bond Stress, I.S. Code Provisions.

Anchorage Zone in Post Tensioned Members, Stress Distribution in End Block, Guyon's Method of Approach of Analysis of End Block (not more than 2 Cables).

#### **Text Books**

1. Prestressed Concrete by N.Krishna Raju., Tata McGraw-Hill Education

#### **Reference Books**

1. Prestressed Concrete by N.Rajagopalan, Alpha Science International.
2. Prestressed Concrete by P. Dayaratnam, Oxford and IBH Publishers.
3. Design of Prestressed Concrete Structures by T.Y. Lin and Ned. H. Burns, Wiley India.

## **5. ELEMENTS OF COASTAL ENGINEERING**

#### **Course Objectives**

- To familiarize the students about the coastal engineering and coastal processes.
- Making student to understand about the generation and propagation of surface gravity waves, tides, storm surges and Tsunamis.
- To impart the skills of analysing the wave transformations and breaking processes.
- To develop the skills to estimate wave forces.

- To develop the skill in analysing the different types of coastal protection structures.

### **Course Outcomes**

Students will be able to

- Understand the different types of coastal processes, beaches, and landforms.
- Learns different types of wave theories and prediction models
- Understands wave transformations and wave breaking
- To familiarize the basic governing equations for the design of coastal protection structures.
- Analyse the wave forces on marine structures.

## **SYLLABUS**

Introduction, General Design Considerations for Coastal Engineering. Long Period Waves: Tides, Seiches, Tsunamis, Storm Surge and Wind Set Up.

Solutions of Linear Wave Equation for Progressive and Standing Waves – Pressure Velocity Fields – Surface Profile and Dispersion Relationship – Principle of Super Position – Wave Energy, Energy Flux and Energy Principle – Group Velocity.

Wave Mechanics. Celerity and Group Velocity. Wind Generated Waves. Wave Statistics.

Wave Transformation: Shoaling, Refraction, Diffraction and Reflection. Wave Breaking Criteria. Wave Forecasting for Deepwater Waves.

Beach Profiles and Surf Zone Wave Breaking. Sediment Transport. Impacts of Coastal Structures on Shoreline Changes. Seawalls, Breakwaters, Groins, Jetties, Wharves.

Wave Forces on Walls. Design of Breakwaters: Rubble Mound-Type, Wall-Type, Structural Cross-Section.

Wave Forces on Piles – Basic Assumptions – Values of the Inertia and Drag Coefficients and Their Dependence on the Wave Theory used.

### **Text Books**

1. Water Wave Mechanics for Engineers and Scientists by R.G.Dean and R.A.Darlymple, World Scientific Publishers.
2. Coastal Hydrodynamics by J.S.Mani. PHI Publishers 2<sup>nd</sup> Edition.

### **Reference Books**

1. Basic Coastal Engineering by R.M.Sorensen, 3<sup>rd</sup> Edition, Springer.

2. Coastal Engineering Manual (CEM). US Army Coastal Engineering Research Center, 2002-2006. (Download from CECIL or USACE website).

## **6. SUBSOIL EXPLORATION AND INSITU SOIL TESTING**

### **Course Objectives:**

- To understand the objectives and stages of subsoil exploration
- To study different methods of soil exploration
- To understand the importance of different types of soil samples used for assessing its properties
- To analyze and interpret the field test data to characterize subsoil
- To prepare a subsoil investigation report

### **Course Outcomes:**

The Students will be able to

- Select the appropriate method of exploration and depth of exploration for a given project at a given construction site
- Understand different methods of boring and their suitability
- Distinguish between thick and thin-walled samplers
- Plan and interpret in-situ soil tests data to evaluate the bearing capacity of soil
- Plan subsoil investigation program and prepare corresponding bore logs and investigation report

## **SYLLABUS**

**SUBSOIL EXPLORATION:** Introduction, Objectives of soil exploration, Stages in Subsoil exploration: Reconnaissance, Preliminary and Detailed investigations; Geophysical Methods: Seismic, Electrical Resistivity Methods; Depth and extent of soil exploration, Methods of exploration: Exploration pits, Boreholes, Methods of Boring: Auger Boring, Wash Boring, Rotary Drilling, Percussion Drilling, Core drilling; Types of soil samples: Disturbed and Undisturbed samples, Thick and Thin-walled samplers.

**IN-SITU SOIL TESTING:** Standard Penetration Test, Static Cone Penetration Test, Dynamic Cone Penetration Test, In situ Vane Shear Test, Observation of Groundwater table, Preparation of Borelogs and Subsoil investigation report.

### **Text Books**

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A.S.R. Rao, New Age International Publications, New Delhi.

2. Soil Mechanics and Foundation Engineering by Dr.K.R.Arora, Standard Publishers Distributors, New Delhi.

### **Reference Books**

4. Head, K. H., Manual of Soil Laboratory Testing, volume 1 to 3, 1981
5. Compendium of Indian Standards on Soil Engineering Parts I and II, 1987 – 1988.

## **7. AIR POLLUTION AND CONTROL**

### **Course Objectives:**

- To provide a general understanding of air quality and its impact on humans, materials, properties, and the local and global effects of air pollution on plants.
- To study the function and transport of air pollutants and their measurement methods.
- Study of sampling types and methods for ambient air and stack.
- Study of macro and micrometeorology for understanding the dispersion of pollutants
- To discuss different types of air pollution control devices and their design principles and limitation.

### **Course Outcomes:**

At the end of the course student will be able to

- Classify and identify the sources of air pollutants
- Assess the effects of air pollutant on human health and environment.
- Apply and illustrate the importance of various air pollution dispersion models.
- Evaluate the air quality and relate it with air pollution regulation
- Design various air pollution control equipment and evaluate its use.

## **SYLLABUS**

Air Pollution and its definition – Factors influencing air pollution – Classification of pollutants particulates – Gases-Sources of pollution – Air qualities standards – effects – Location of Industries.

Meteorology – Wind roses – lapses rates – mixing depth atmospheric dispersion – plume behavior, accumulation, estimation of pollutants – Effective stack height.

Air Pollution effects on human beings, animals, plants and materials – Air Pollution Episodes in India and abroad.

Ambient air quality monitoring and stack monitoring.

Control of air pollution – Removal of pollutants – particulate and gaseous – Air pollution control equipments (units) such as settling chamber, cyclones, wet scrubbers/collectors, scrubbers, centrifugal scrubbers spray towers, packed beds, electrostatic precipitators, after burners-absorption – adsorption – Diffusion.

### **Reference Books**

- 1) Air Pollution Control Technology by T. Painter.
- 2) Elements of Air Pollution Control by Prof. T. Shivaji Rao.
- 3) Air Pollution Control by K.V.S.G. Murali Krishna.
- 4) Fundamentals of Air Pollution by Dr. B.S.N. Raju, Oxford & I.B.H.

## **8. DESIGN AND DETAILING OF REINFORCED CONCRETE AND STEEL STRUCTURES**

### **Course Objectives:**

- Know the design of various types of retaining walls with detailing.
- Familiarize with the design and detailing of circular and rectangular water tanks.
- Design combined footings including detailing.
- Design plate girders and gantry girders with detailing.
- Analyse and design web stiffeners and bridges.

### **Course Outcomes:**

At the end of the course, the students will be able to

- Analyze and design various types of retaining walls along with detailing.
- Analyze and design circular and rectangular water tanks along with detailing.
- Design combined footings including detailing.
- Analyze and design plate girders and gantry girders along with detailing.
- Design web stiffeners and bridges including detailing.

## **SYLLABUS**

### **REINFORCED CONCRETE STRUCTURES:**

Design and detailing of cantilever and counterfort retaining walls.

Design and detailing of rectangular and circular water tanks.

Design and detailing of combined footings.

### **STEEL STRUCTURES:**

Design and detailing of plate girders.

Design and detailing of web stiffeners.  
Design and detailing of gantry girders.  
Design and detailing of bridges.

## **9. ANALYSIS AND DESIGN OF PAVEMENTS**

### **Course Objectives:**

- To familiarise the students with types of pavements and stress distribution for theoretical and actual subgrade conditions.
- To impart knowledge about design principles and methods for flexible and rigid pavements.
- To impart knowledge of concrete block pavements for different traffic loading conditions.
- To impart knowledge of environmental effects and influences on pavement condition.
- To impart knowledge of pavement management systems including overlays and maintenance.

### **Course Outcomes:**

Students will be able to

- Understand stress distribution in pavements for different traffic loading conditions.
- Understand concrete block pavements with types of pavement distresses.
- Understand pavement instrumentation and condition with origin and remedy.
- Understand roughness and skid resistance in different environmental conditions.
- Understand pavement overlays and maintenance activities to be conducted for both Flexible and Rigid pavements.

## **SYLLABUS**

Pavement types, stress distribution pavements - theoretical and actual Subgrade conditions and traffic loading. Design principles and methods for flexible and rigid pavements.

Design of Concrete block pavements.

Evaluation of pavement condition, pavement instrumentation: Types of pavement distresses, their origins and remedy.

Roughness and skid resistance. Environmental effects and influences. Pavement maintenance, overlays.



**Reference Books:**

1. Pavement Analysis and Design, second edition, by Yang H. Huang, Prentice Hall publishers.
2. Shell Pavement Design Manual - asphalt pavements and overlays for road traffic, by Nilanjan Sarkar, Ooms Avenhorn Holding India Pvt.Ltd;
3. Highway engineering by Khanna & Justo .

## 10. PROJECT PLANNING AND MANAGEMENT

**Course Objectives:**

- Enable students to understand importance of planning and management of construction projects and different elements of a construction management.
- Impart skills of network techniques in solving construction industry projects.
- Explore students to understand updating, resource leveling and smoothing of construction projects.
- Enable students to learn about contracts, tenders and various works and works measurement standards.
- Familiarize with the labour problems and labour legislation in India.

**Course Outcomes:**

The students will be able to

- Understand importance of planning, scheduling and controlling the construction projects.
- Draw the bar charts, networking diagrams using CPM and PERT to assess the completion time of the project.
- Understand and know the various types of contracts and works related to construction projects.
- Understand the significance and concept of scientific construction management, labour problems in construction projects.
- Discuss various labour problems and labour legislation in India.

### SYLLABUS

PERT and CPM : Introduction : Origin of PERT and CPM, Planning, Scheduling and controlling Bar charts, Milestone charts, weaknesses in Barcharts, PERT and CPM networks – Comparison, Event, Activity, Rules for drawing networks, Numbering the events (Fulkerson's law : Dummy activities, Time estimate-Expected time, Earliest allowable occurrence time, Latest allowable occurrence time, slack, project duration, probability of completion, Start and Finish time estimates, Floats, Project scheduling, Critical and sub-critical path.

Cost analysis / updating / resource scheduling: Cost Analysis direct and indirect costs, operation time, Normal and crash points, optimising project cost, crash limit, Free float limit, Optimisation. Updating – Process of updating; when to update, Resource scheduling – Resource smoothing. Resource levelling, circle notation and arrow notation.

Contracts: Contracts – Element of contract, offer acceptance and consideration, valid contract, Department execution of works, Master Roll Form 21. Piece work Agreement form, work order; Contract system with tenders – Definitions – Contract, Contractor, Quotation, Earnest money, Security money, Tender, Tender notice, Tender form, Bidding procedure, Irregularities in Bidding, award, Types of contracts – Lumpsum contract; Lumpsum and schedule contract, Item rate contract, sub-contracts, joint ventures, Arbitration Disputes and claim settlement.

Management – Scope of the Construction Management, Significance of Construction management, Concept of Scientific Management, Qualities of Manager, Organization – Authority, Policy, Recruitment process and Training Development of Personnel Department.

Labour problems, Labour legislation in India, Workmen compensation Act 1923, and subsequent amendments, Minimum Wages Act 1948.

### **Reference Books**

1. PERT and CPM – L. S. Srinath.
2. PERT and CPM – Punmia.
3. Estimating and Costing – B.N. Dutta.
4. Construction Management and Planning – Guna and Sen Gupta, B.

## **11. GROUND IMPROVEMENT TECHNIQUES**

### **Course Objectives:**

- To study the need and importance of ground improvement techniques
- To understand various methods adopted for stabilizing different types of soils
- To study different methods of in-situ densification of soils
- To understand the suitability and applications of grouting technique
- To impart knowledge about the concept of reinforced earth and applications of geosynthetics in reinforced soil structures

### **Course Outcomes:**

At the end of the course student will be able to

- Identify the problem and suggest suitable method to improve soil characteristics
- Understand the effectiveness of radial consolidation in densification of clays

- Illustrate the construction methods for stabilizing soils using lime and cement
- Perform analysis and design reinforced earth retaining walls
- Design suitable ground improvement system in weak soils

## **SYLLABUS**

**In-situ Densification Methods in Granular Soils:** Introduction of Vibration at the Ground Surface, Impact at the Ground Surface, Vibration at Depth, Impact at Depth.

In-situ Densification Methods in Cohesive Soils: Introduction, Preconsolidation Preloading using Sand Drains, Sand Wicks, and Geodrains/Band drains, Forced Vacuum Preconsolidation, Stone and Lime Columns, Thermal Methods.

**Grouting:** Objectives, Suspension, Emulsion and Solution Grouts, Categories of Grouting, Grouting Equipment, Stage Grouting in Soils by Tube-a-Manchettee, Ascending and Descending Stage Grouting, Hydro fracture, Grout Control

**Reinforced Earth:** Principles, Components of Reinforced Earth – Fill, Reinforcing Material and Facing, Evaluation of Interfacial Friction of Fill and Reinforcing Material, Applications of Reinforced Earth, Design Principles of Reinforced Earth Walls

Geotextiles: Introduction, Types of Geotextiles; Functions and their Application, Tests for Geotextiles

**Soil Stabilization:** Objectives, Methods of Stabilisation, Mechanical Stabilization: Proportioning of Materials by Rothfutch's Method, Factors affecting Mechanical Stabilization, Cement and Lime Stabilization: Mechanisms, Engineering Benefits, Factors affecting Cement and Lime Stabilization, Construction Techniques, Bituminous Stabilization: Types of Soil – Bitumen, Factors affecting Bituminous Stabilization of Soils, Construction Methods.

Deep Mixing of Soils with Lime/Cement: Lime-soil Columns, Soil-Cement Columns, Construction Methods, Applications.

**Stone Columns:** Introduction, Construction Methods – Vibroflotation Technique and Rammed Stone Column, Functions and limitations.

### **Text Bookss**

1. Ground Improvement Techniques, P.Purushothama Raj, Lakshmi Publications (P) Ltd.

### **Reference Books**

1. Engineering Principles of Ground Modification, Monfred R Hausmann, Mc Graw-Hill Publishing Co.
2. Highway Engineering, Khanna S.K. and Justo C.E., Nem chand Publications.

## 12. SOLID WASTE MANAGEMENT

### Course Objectives:

- To familiarise the student on the sources and types of solid wastes
- To impart knowledge of solid waste management principles
- To input knowledge on waste segregation methods
- To develop skills of composting and familiarise with incineration methods
- To impart knowledge of waste disposal by sanitary landfill

### Course Outcomes:

Upon successful completion of this course students will be able to:

- Gains the knowledge about the sources and types of solid wastes.
- Evaluate the characteristics of municipal solid waste.
- Analyse the problems due to improper disposal of solid waste and understand the integrated solid waste management options.
- Explain the merits and demerits of composting and incineration.
- Perform the analysis and design of sanitary landfill.

### SYLLABUS

**Introduction:** Definition of Solid Waste, Garbage, Rubbish–Sources and Types of Solid Wastes. Characteristics of Solid Wastes: Physical, Chemical and Biological Characteristics– Problems due to Improper Disposal of Solid Waste.

**Solid Waste Management:** Definition– Reduction, Reuse, Recycling and Recovery Principles of Waste Management – Functional Elements of Solid Waste Management – Waste Generation and Handling at Source – Collection of Solid Wastes – Collection Methods and Services– Guidelines for Collection Route Layout.

**Transfer and Transport of Wastes:** Transfer Station – Processing and Segregation of the Solid Waste – Various Methods of Material Segregation.

**Processing and Transformation of Solid Wastes:** Composting: Definition–Methods of Composting – Advantages of Composting – Incineration: Definition – Methods of Incineration– Advantages and Disadvantages of Incineration.

**Disposal of Solid Waste:** Volume Reduction, Open Dumping, Land Filling Techniques. Landfills: Classification–Design and Operation of Landfills, Land Farming, Deep Well Injection.

### **Text Books**

1. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous, Hilary Theisen, Samuel A Vigil. McGraw-Hill Series in Water Resources and Environmental Engineering.
2. Environmental Engineering by Howard S.Peavy, Donald R.Rowe and George Tchobanoglous.

## **HSS ELECTIVE**

### **1. INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP (Effective from the admitted Batch 2020-2021)**

#### **Course Objectives:**

- To familiarize the students with the concepts of Management.
- To relate the concepts of Management with industrial organizations.
- To explain the factors affecting productivity and how productivity can be increased in an Industrial undertaking.
- To set forth a basic framework for understanding Entrepreneurship.

#### **Course Outcomes:**

On completion of the course, the students will be able to:

- Understand the roles, skills and functions of management.
- Distinguish the different types of business organizations.
- Identify the factors involved in Production Operations Management.
- Diagnose organizational problems and take suitable decisions.
- Establish good Human Resource Management practices.
- Acquire necessary knowledge and skills required for organizing and carrying out entrepreneurial activities.

## **SYLLABUS**

**Basic Concepts of Management:** Management: - Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor's Scientific Management; Henry Fayol's Principles of Management;

**Forms of Business Organizations:** Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

**Production and operations Management:** Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

**Entrepreneurship:** Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, , Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

**Entrepreneurial Development and Project Management:** Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

**Text Books:**

1. Sharma, S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth), Himalayan Publishing House, 2018.

**Reference Books:**

1. Aryasri, A.R., Management Science, McGraw Hill Education (India Private Limited , New Delhi 2014.
2. Sheela, P., and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

## **2. ORGANIZATIONAL BEHAVIOUR (Effective from admitted batch 2020-2021)**

**Course Objectives:**

- To understand the basic concepts of organizational behaviour, its foundations and importance.
- To enable students to have a basic perspective of Motivation and Motivation theories.
- To acquaint the students about group behaviour in organizations, including communication, leadership conflicts and organizational change and how these are linked to and impact organizational performance.

**Course Outcomes:**

- Identifying fundamental aspects of organizational dynamics.
- Evaluate main theories of motivation and formulating suitable motivational strategies.
- Analyze the behaviour of individuals and groups in organizations.
- Understanding of Leadership theories and Leadership behaviour.
- Apply relevant theories, concepts to address important Organizational Behaviour questions.

**SYLLABUS**

**Organisational Behaviour :** Concept of Organisation - Concept of Organisational Behaviour - Nature of Organisational Behaviour - Role of Organisational behaviour - Disciplines contributing to Organisational Behaviour.

**Motivation:** Définition - Nature of Motivation - Role of Motivation - Theories of Motivation : Maslow's Need Hierarchy Theory, Herzberg's Motivation Hygiene Theory and Mc Gregor's Theory X and Theory Y.

**Group Dynamics:** Meaning - Concept of Group - Types of groups -Formal and Informal groups - Group development - Group cohesiveness and factors affecting group cohesiveness.

**Leadership:** Concept of Leadership - Difference between Leadership and Management - Importance of Leadership - Leadership styles: Autocratic leadership, Participative leadership and Free Rein leadership.

**Communication:** Meaning - Communication Process - Forms of communication: Oral, Written and Non- Verbal communication - Direction of communication : Downward, Upward and Horizontal communication.

**Organisational conflicts:** Concept of conflict - Reasons for conflict - Types of Conflict: Intrapersonal conflict, Interpersonal conflict, Intragroup conflict, Intergroup conflict, Interorganisational conflict - Conflict management.

**Organisational Change:** Nature - Factors in Organisational change -Planned change: Process of planned change - Resistance to change: Factors in résistance to change - Overcoming résistance to change.

**Text Books :**

1. L.M.Prasad: Organisational Beaviour, Sultan Chand & Sons, New Delhi -110002
2. K. Aswathappa: Organisational Behaviour, Himalaya Publishing House, New Delhi

### Reference Books.

1. Stephen Robbins: Organisational Behaviour, Pearsons Education, New Delhi.

## 3. OPERATIONS RESEARCH

### Course Objectives:

- Formulate a real world problem as a mathematical programming model.
- Provide knowledge of optimization techniques and approaches.
- Understand and study inventory problems.
- Know the network models.
- Put on knowledge in solving replacement problems and different queueing models

### Course Outcomes:

- Learned to translate a real-world problem into a mathematical formulation.
- Formulate and Solve Transportation, Assignment and sequencing problems.
- Resolve inventory problems.
- Able to solve maximum flow and shortest path problems.
- Capable to solve replacement problems and analyze queueing models.

## SYLLABUS

**Introduction:** Definitions of Operations Research; Phases of Operations Research; Types of Operations Research models; applications, merits and demerits of Operations Research.

**Allocation:** Linear Programming problem formulation; Basic assumptions; Graphical solution; Simplex method; Artificial variable technique; Two phase method; Big M method; Duality principle; Primal and Dual relation.

**Transportation:** Formulation; Solution methods; Unbalanced transportation problems - North west corner rule; Least cost entry method; Vogel's approximation method; Optimal solution; degeneracy.

**Assignment:** Formulation; Variations in Assignment problem; Travelling salesman problem.

**Sequencing:** Sequencing of  $n$  jobs through two machines;  $n$  jobs through three machines;  $n$  jobs through  $m$  machines; 2 jobs through  $m$  machines.

**Inventory Control:** Introduction; Types of Inventory; Inventory costs; Deterministic models - Economic order quantity (EOQ) and Economic Production Quantity (EPQ) with and without



shortages; Quantity discounts; P system; Q system; Inventory control Techniques.

**Network Analysis:** Network definitions; Time estimates in network analysis; Labeling using Fulkerson's rule; Forward pass computations; Backward pass computations; Project management using Critical Path Method(CPM) and Programme Evaluation and Review Technique(PERT).

**Replacement:** Introduction, Replacement of items that deteriorate with time - Value of money unchanging and changing, Replacement of items that fail completely.

**Queueing models:** Introduction; Single channel poisson arrivals; Exponential service times; Unrestricted queue with infinite population and finite population models; Multi channel poisson arrivals; Exponential service times with infinite population and restricted queue.

**Text Books:**

1. Hamdy A Taha, "Operations Research- An Introduction" by TAHA , Prentice Hall, 2009.
2. F.S. Hiller, G.J. Liberman, B. Nag and P. Basu "Introduction To Operations Research, Mc Graw Hill Education(India), 2012.
3. S.D.Sharma, "Operations Research", Kedarnadh Ramnadh & Co.,2017

**Reference Books:**

1. R. Pannerselvam, "Operations Research", PHI..
2. Richard Bronson, Schaum's Series, " Operations Research", Mc Graw Hill
3. N.V.S.Raju, "Operations Research- Theory and Practice" BS publications.
4. V.K. Kapoor, "Operations Research" Sultan Chand & Sons.