**Total Credits= 21**

| Semester-VI (B. Tech Civil Engg.) | | Contact Hours | | | Max Marks | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|
| Subject Code | Subject Name | L | T | P | Int. | Ext. | | |
| BCIES1-601 | Design of Steel Structures-I | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BCIES1-602 | Structural Analysis-II | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BCIES1-603 | Transportation Engineering-I | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BCIES1-604 | Foundation Engineering | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| **Departmental Elective-III (Select any one)** | | | | | | | | |
| BCIED1-611 | Irrigation Engineering-I | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| BCIED1-612 | Matrix Methods of Analysis | | | | | | | |
| BCIED1-613 | Rural Water supply and Onsite Sanitation Systems | | | | | | | |
| **Departmental Elective-IV (Select any one)** | | | | | | | | |
| BCIED1-621 | Construction Project Planning & Systems | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| BCIED1-622 | Building Construction Practice | | | | | | | |
| BCIED1-623 | Pavement Design | | | | | | | |
| **Departmental Elective-V (Select any one)** | | | | | | | | |
| BCIED1-631 | Water & Wastewater Treatment | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| BCIED1-632 | Ground Improvement Techniques | | | | | | | |
| BCIED1-633 | Pavement Construction and Management | | | | | | | |
| BCIED1-634 | Earthquake Engineering | | | | | | | |
| BCIES1-605 | Transportation Engineering Lab | 0 | 0 | 2 | 60 | 40 | 100 | 1 |
| BCIES1-606 | Computer-aided Civil Engineering Drawing Lab-II | 0 | 0 | 2 | 60 | 40 | 100 | 1 |
| **Total** | | **-** | **-** | **-** | **400** | **500** | **900** | **21** |

*There will be 4-6 weeks Internship as per AICTE Internship Policy after 6$^{th}$semester.

## DESIGN OF STEEL STRUCTURES-I

**Subject Code: BCIES1-601** **L T P C** **Duration: 45 hrs.**

3 0 0 3

**Course Objectives:**

1. Learn the behaviour of structural steel components Ability to perform analysis and design of steel members and connections.
2. Ability to design steel structural systems learns the behaviour of structural steel components.

**Course Outcomes:**

1. Identify the different failure modes of bolted and welded connections, and determine their design strengths.
2. Identify the different failure modes of steel tension and compression members and beams, and compute their design strengths.
1. Select the most suitable section shape and size for tension and compression members and beams according to specific design criteria.

**Note: IS 800:2007, General construction in Steel-Code of practice is permitted in examination.**

### UNIT-I (11 Hours)

**Introduction**: Properties of structural steel, I.S. rolled sections, I.S. specifications.
**Connections**: Riveted, bolted and welded connections for axial and eccentric loads (Type-I&II).

### UNIT-II (12 Hours)

**Tension Members**: Introduction, Mode of Failure, IS Specifications, Design of members subjected to axial tension using bolts and welds.
**Compression Members**: Introduction, buckling, effective length, slenderness, effects of end supports, Design of axially loaded members, built-up columns, laced and battened columns including the design of lacing and battens using bolts and welds.

### UNIT-III (11 Hours)

**Flexural Members:** Plastic behavior, beam types, Shear in beam, bending, splices, Design of laterally restrained and un-restrained rolled and built-up sections using bolts and welds.
**Foundation**: Types, Anchor bolts, bearing plate, Design of slab base, gusseted base and grillage foundation using bolts and welds.

### UNIT-IV (11 Hours)

**Roof Truss**: Introduction, Terminology, types & uses, types of load, purlins, Design of roof truss using bolts and welds.

**Recommended Text Books / Reference Books:**

1. S.K. Duggal, 'Limit State Design of Steel Structures', McGraw Hill.
2. N. Subramanian, 'Design of Steel Structures', Oxford Higher Education.
3. 'Design of Steel Structures', Vol. -1, Ram Chandra Standard Book House – Rajsons.
4. S S Bhavikatti, 'Design of Steel Structures' (by limit state method as per IS: 800-2007)', I.K. International Publishing House.
5. IS 800: 2007 (General construction in Steel-Code of practice)

## STRUCTURAL ANALYSIS-II

**Subject Code: BCIES1-602** | **L T P C** | **Duration: 45 Hrs.**

3 0 0 3

**Course Objectives:**

1. To provide students with a solid background on principles of structural analysis by exposing them to the theories and concepts of analyzing the civil engineering structures.
2. To cover the analysis of statically indeterminate structures.

**Course Outcomes:**

1. The students will possess the skills to solve statically indeterminate problems of structural analysis dealing with different loads.
2. They will be able to apply their knowledge of structural analysis to address structural design problems.

### UNIT-I (11 Hours)

**1. Analysis of Statically Indeterminate Structures:** Degree of static and kinematic indeterminacies, analysis of indeterminate beams, rigid frames and trusses by method of consistent deformation, law of reciprocal deflections, method of least work, induced reactions on statically indeterminate beams & rigid frames due to yielding of supports.

**2. Fixed & Continuous Beams:** Introduction, Analysis of fixed beams by moment-area theorem and strain energy method, fixed end moments due to different types of loadings, sinking and rotation of supports, bending moment and shear force diagrams for fixed beams, slope and deflection of fixed beams, analysis of continuous beams by the Three moment equation (Clapeyron's theorem) due to different types of loadings, effect of sinking of supports, BMDs.

### UNIT-II (12 Hours)

**3. Slope-Deflection Method:** Introduction, slope-deflection equations, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements.

**4. Moment-Distribution Method:** Introduction, absolute and relative stiffness of members, stiffness and carry-over factors, distribution factors, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loads and uneven support settlements, symmetrical beams and frames with symmetrical, skew-symmetrical and general loading.

### UNIT-III (11 Hours)

**5. Rotation Contribution Method:** Introduction, basic concept, analysis of statically indeterminate beams and rigid frames (sway and non-sway type) due to applied loadings and yielding of supports, symmetrical beams and frames, general case-storey columns unequal in height and bases fixed or hinged.

**6. Approximate Methods of Structural Analysis:** Introduction, Vertical and lateral load analysis of multi-story frames, portal, cantilever and substitute-frame methods and their comparison.

### UNIT-IV (11 Hours)

**7. Two Hinged Arches:** Introduction, Analysis of two hinged arches for Horizontal Thrust, Bending Moment, Normal Thrust, and Radial Shear, Settlement (Foundation Yielding) and

Temperature Effects, Rib Shortening and Shrinkage, Influence Lines for Two Hinged Arches.

**8. Influence Lines for Statically Indeterminate Structures:** Muller- Breslau principle for statically determinate and indeterminate beams, trusses and rigid frames, influence lines for reactions, shear force and bending moment for statically indeterminate beams, trusses and rigid frames.

**Recommended Text Books / Reference Books:**

1. C.S. Reddy, 'Basic Structural Analysis'.
2. C.K. Wang, 'Intermediate Structural Analysis'.
3. J. Sterling Kinney, 'Indeterminate Structural Analysis'.
4. B.C. Punmia, 'Theory of Structures'.

## TRANSPORTATION ENGINEERING-I

**Subject Code: BCIES1-603** | **L T P C** | **Duration: 45 hrs.**

3 0 0 3

**Course Objectives:**

1. The objective of this course is to acquaint the students about highway planning and development in India.
2. The course will cover selection of highway alignment, design of geometric elements of highways, carry out traffic studies and implement traffic regulation and control measures and intersection design.
3. The characteristic properties of road construction materials and design of flexible and rigid pavements as per IRC guidelines shall also be covered in this course.

**Course Outcomes:**

1. The student will learn about essentials of highway planning and features of highway development in India.
2. The student will learn how to do selection of highway alignment and design the geometric elements of highways.
3. The student will learn how to carry out traffic studies and implement traffic regulation and control measures and intersection design.
4. The student will know about characteristic properties of road construction materials and design the flexible and rigid pavements as per IRC guidelines.

**UNIT-I (12 Hours)**

**Highway Development and Planning:** Classification of roads, road development in India, current road projects in India, highway alignment and project preparation.

**Geometric Design of Highways:** Highway cross section elements, sight distance, design of horizontal alignment, design of vertical alignment.

**UNIT-II (11 Hours)**

**Traffic Characteristics & Studies: R**oad user characteristics, driver characteristics, vehicular characteristics. Volume studies, speed studies, O-D survey, parking study.

**Traffic Safety and Control Measures: T**raffic signs, markings, islands, signals, cause and type of accidents, use of intelligent transport system.

**UNIT-III (11 Hours)**

**Pavement Materials:** Materials used in highway construction- soils, stone aggregates, bituminous binders, desirable properties, tests, requirements for different types of pavements.
**Paving Mixes:** Marshall method of bituminous mix design, Super pave and Concrete mix design for rigid pavements.

**UNIT-IV (11 Hours)**

**Design of Pavements:** Pavement types, factors affecting design and performance of pavements, flexible pavements- components and functions, stresses in flexible pavements, design of flexible pavements as per IRC.
**Rigid Pavements**- components and functions, stresses in rigid pavements, design of cement concrete pavements as per IRC.

**Recommended Text Books / Reference Books:**


1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Nem Chand & Bros., Roorkee.
2. Kadiyali, L.R., 'Traffic Engineering and Transport Planning', Khanna Publishers, Delhi.
3. Partha Chakraborty, ' Principles of Transportation Engineering, PHI Learning, New Delhi.
4. S.K. Sharma, 'Principles, Practice & Design of Highway Engineering', S. Chand & Company Ltd., New Delhi.
5. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski, 'Principles of Highway Engineering and Traffic Analysis', John Wiley& Sons, USA.
6. Paul H. Wright and Karen K. Dixon, 'Highway Engineering', Wiley Student Edition, USA.
7. C.A.O. Flaherty, 'Highway Engineering', Vol. 2, Edward Arnold, London.


## FOUNDATION ENGINEERING

**Subject Code: BCIES1-604** | **L T P C** | **Duration: 45 hrs.**

3 0 0 3

**Course Objectives:**

1. Analyse earth retaining structures to determine earth pressures.
2. Analyse bearing capacity of soils under shallow footings.
3. Design shallow footings based on dimensions, thickness, area and length.
4. Determine the bearing capacities of single pile in sand and clay using static method and the distribution of load in group piles as well as their efficiencies.
5. Conduct basic technical investigations, compile and analyse information, and produce a brief and concise report with an appropriate conclusion.

**Course Outcomes:**

After successful completion of this course, the students would:

1. Learn about types and purposes of different foundation systems and structures.
2. Have an exposure to the systematic methods for designing foundations.
3. Be able evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soil behaviour.

4. Have necessary theoretical background for design and construction of foundation systems.

**UNIT-I (11 Hours)**

**Soil Investigation**: Soil Investigation for new and existing structures. Depth of exploration for different structures, spacing of bore Holes, Methods of soil exploration and relative merits and demerits. Types of soil sample. Design features of sampler affecting sample disturbance, Essential features and application of various types of samplers, Geophysical exploration by seismic and electrical resistivity methods, Standard Penetration Test and Plate load test, Bore hole log.

**Stresses in Soil**: Boussinesq's equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams, Isobars, New mark's chart and its construction, Approximate method of load distribution, Comparison of Boussinesq's and Westergaard analysis for a point load.

**UNIT-II (11 Hours)**

**Earth Pressure**: Terms and symbols used for a retaining wall, Movement of wall and the lateral earth pressure, Earth pressure at rest, Rankine states of plastic equilibrium, Coefficient of active and passive earth pressures for horizontal backfills, Rankine's theory both for active and passive earth pressure for Cohesion-less and cohesive soil, Coulomb's method for cohesion less backfill, Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load).

**UNIT-III (12 Hours)**

**Shallow Foundation**: Type of shallow foundations, Factors affecting choice of foundation, Factors affecting the depth of foundation. Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity, Terzaghi's analysis. Types of failures, Factors affecting bearing capacity, Skempton's equation, B.I.S. recommendations for shape, depth, inclination factors and water table corrections, Causes of settlement of structures, Immediate and consolidation settlement, calculation of settlement by plate load Test and Static Cone penetration test data, Allowable settlement of various structures according to I.S. Code, Introduction of rafts and floating foundation.

**UNIT-IV (11 Hours)**

**Pile Foundations**: Types, Necessity and uses of piles, Classification of piles, Types of pile driving hammers & their comparison, Determination of load carrying capacity of driven piles by dynamic formulae, Cyclic Pile Load Test, Determination of point resistance and frictional resistance of a single pile by Static formulas in sand and clay, Spacing of piles in a group, Group action of piles, Calculation of settlement of friction pile group in clay, Settlement of pile groups in sand, Negative skin friction.

**Caissons and Wells**: Major areas of use of caissons, advantages and disadvantages of open box and pneumatic caissons, Essential part of a pneumatic caisson, Components of a well foundation, Calculation of allowable bearing pressure, Conditions for stability of a well, Forces acting on a well foundation, Computation of scour depth.

**Recommended Text Books / Reference Books:**

1. K.R. Arora, 'Soil Mech. & Foundation Engineering,' Standard Publishers Distributors.

2. V.N.S. Murthy, 'Soil Mech. & Foundation Engineering'.
3. Gopal Ranjan and A.S.R. Rao, 'Basic and Applied Soil Mechanics', New Age International.
4. Muni Budhu, 'Soil Mech. & Foundations', Wiley, John Wiley & Sons.
5. Gulhati and Datta, 'Geotechnical Engineering', Tata McGraw Hill Education.

**IRRIGATION ENGINEERING –I**

| **Subject Code: BCIED1-611** | **L** | **T** | **P** | **C** | **Duration: 30 Hrs.** |
|---|---|---|---|---|---|
| | 2 | 0 | 0 | 2 | |

**Course Objectives**:

The course should enable the students to:

1. The concepts, techniques and modernization of irrigation.
2. Design lined and un-lined canals for irrigations.
3. Different theories/ methods to design lined and un-lined canals.
4. Losses in canals and its control measures.
5. Construction of well and tube well.
6. River training works.

**Course Outcomes:**

Upon successful completion of this course, student will be able to:

1. Recognize the concepts, techniques and modernization of irrigation.
2. Plan and design lined and un-lined canals for irrigations.
3. Apply different theories/ methods to design lined and un-lined canals.
4. Learn losses in canals and its control measures.
5. Design and construction of well and tube well.
6. Learn about river training works.

**UNIT-I (07 Hours)**

**1. Introduction:** Importance of irrigation engineering, purposes of irrigation, objectives of irrigation, benefits of irrigation, advantages of various techniques of irrigation: Furrow irrigation, boarder strip irrigation, basin irrigation, sprinkler irrigation, drip irrigation.

**2. Methods of Irrigation:** Advantages and disadvantages of irrigation, water requirements of crops, factors affecting water requirement, consumptive use of water, water depth or delta, Duty of water, relation between delta, duty and base period, Soil crop relation-ship and soil fertility.

**UNIT-II (08 Hours)**

**3. Canal Irrigation:** Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Silt theories-Kennedy's theory, Lacey's theory, Drawbacks in Kennedy's & Lacey's theories, comparison of Lacey's and Kennedy's theories, Design of unlined canals based on Kennedy & Lacey's theories, suspended and bed loads.

**4. Lined canals:** Types of lining, selection of type of lining, Economics of lining, maintenance of lined canals, silt removal, strengthening of channel banks, measurement of discharge in channels, design of lined canals, methods of providing drainage behind lining.

**UNIT-III (07 Hours)**

**5. Losses in canals, water logging and drainage:** Losses in canals-Evaporation and seepage,

water logging, causes and ill effects of water logging- anti water logging measures. Drainage of land, classification of drains - surface and subsurface drains Design considerations for surface drains, Advantages and maintenance of tile drains.

**6. River training works:** Objectives, classification of river-training works, Design of Guide Banks. Grayness or spurs - Their design and classification, ISI Recommendations of Approach embankments and afflux embankments, pitched Islands, natural cut-offs and artificial cut-offs and design Considerations.

**UNIT-IV (08 Hours)**

**7. Tube well Irrigation:** Types of tube - wells - strainer type, cavity type and slotted type. Type of strainers, Aquifer, porosity, uniformity coefficient, specific yield & specific retention, coefficients of permeability, transmissibility and storage. Yield or discharge of a tube well, Assumptions, Theim's & Dupuit's formulae, Interference of tube wells with canal or adjoining tube-wells, optimum capacity, causes of failure of tube wells. Duty and delta of a tube well. Rehabilitation of tube well.

**Recommended Text Books / Reference Books:**

1. Principles & practice of Irrigation Engg. S.K. Sharma
2. Irrigation & Water Power Engg. B.C. Punmia, Pande, B.B. Lal
3. Fundamentals of Irrigation Engg. Dr. Bharat Singh
4. Irrigation Engg. & Hydraulic Structure S.R. Sahasrabudhe
5. Irrigation Engg. & Hydraulic Structure Varshney, Gupta & Gupta
6. Irrigation Engg. & Hydraulic Structure Santosh Kumar Garg.

## MATRIX METHODS OF ANALYSIS

| Subject Code: BCIED1-612 | L | T | P | C | Duration: 30 Hrs. |
|---|---|---|---|---|---|
| | 2 | 0 | 0 | 2 | |

**Course Objectives:**

1. To provide a reasonably comprehensive treatment of matrix methods in structural analysis of skeletal i.e. framed structure in recent years.
2. To develop the elegant finite element method which is nothing but the extension of it?
3. To give engineering students and practicing professionals the fundamentals of the background theory necessary in commercial frame analysis program.

**Course Outcomes:**

1. Students will be able to analyze skeletal i.e. framed structures.
2. They will be able to differentiate between the flexibility and stiffness methods of structural analysis.
3. They will be able to access computers that permits the use of the stiffness method for analyzing traditional civil engineering structures, air frame, space structures etc.

**UNIT-I (08 Hours)**

**1. Basic Concepts of Structural Analysis:** Introduction, Types of Framed Structures,

Deformations in Framed Structures, Equilibrium, Compatibility, Static and kinematic indeterminacies of beams, rigid-jointed plane and space frames, pin-jointed plane and space frames and hybrid structures, Structural Motilities, Principle of Superposition, Equivalent Joint Loads, Energy Concepts and Virtual Work.

**2. Flexibility & Stiffness Matrices:** Actions and Displacements, Action and Displacement equations, Generalized System of Coordinates, Slope-Deflection equations in Generalized Coordinates, Axes and Coordinates, Flexibility and Stiffness Influence Coefficients, Flexibility Matrix, Stiffness Matrix, Relation between Flexibility and Stiffness Matrices, Basic definitions and types of matrices, matrix operations, matrix inversion, solution of linear simultaneous equations, matrix partitioning.

**UNIT-II (07 Hours)**

**3. Flexibility Matrix (Physical Approach):** Development of flexibility matrices for statically determinate and indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using physical approach.

**4. Stiffness Matrix (Physical Approach):** Development of stiffness matrices for statically determinate and indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using physical approach, reduced stiffness matrix, total stiffness matrix, translational or lateral stiffness matrix.

**UNIT-III (08 Hours)**

**5. Flexibility Matrix (Element Approach):** Transformation of system forces to element forces through force transformation matrix, Development of flexibility matrices for statically determinate & indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using Element Approach.

**6. Stiffness Matrix (Element Approach):** Transformation of system displacements to element displacements through displacement transformation matrix, Development of stiffness matrices for statically determinate and indeterminate beams, rigid-jointed plane frames and pin-jointed plane frames using Element Approach.

**UNIT-IV (07 Hours)**

**7. Flexibility Method of Analysis:** Analysis of continuous beams, rigid-jointed plane frames and pin-jointed plane frames using the physical and element approaches, effect of support settlements, temperature stresses and lack of fit.

**8. Stiffness Method of Analysis:** Analysis of continuous beams, rigid-jointed plane frames and pin-jointed plane frames using the physical and element approaches, effect of support settlements, temperature stresses and lack of fit, comparison of flexibility and stiffness methods of analysis.

**Recommended Text Books / Reference Books:**

1. G.S. Pandit and S.P. Gupta, 'Structural Analysis, A Matrix Approach'.
2. William Weaver, Jr. James M. Gere, 'Matrix Analysis of Framed Structures'.
3. C.S. Reddy, 'Basic Structural Analysis'.
4. C.S. Krishnamurthy, 'Finite Element Analysis'.
5. O.C. Zeincwicz, 'Finite Element Methods'.

## RURAL WATER SUPPLY & ONSITE SANITATION SYSTEMS

**Subject Code: BCIED1-613** **L T P C** **Duration: 30 Hrs.**

2 0 0 2

**Course Objectives:**

The course should enable the students to:

1. Learn about water supply in rural areas
2. Learn about environmental sanitation methods in rural areas
3. Comprehend the global picture of water/sanitation/hygiene and health
4. Understanding the principles of operation of a range of appropriate water and sanitation technologies, and to be able to critically evaluate them with respect to multiple criteria
5. Investigate the concept of community participation and its role in enabling project success and sustainability.

**Course Outcomes:**

Upon successful completion of this course, student will be able to:

1. Knowledge about water supply scheme in rural areas.
2. Knowledge about environmental sanitation methods and design in rural areas.

**UNIT-I (07 Hours)**

**Sanitation in Rural Area**: Concept of environmental and scope of sanitation in rural areas, Magnitude of problem of water supply and sanitation – population to be covered and difficulties National policy, Various approaches for planning of water supply systems in rural areas, Selection and development of preferred sources of water, springs, wells and infiltration galleries, collection of raw water from surface source.

**UNIT-II (08 Hours)**

**Water Treatment for Rural Areas:** Specific problem in rural water supply and treatment e.g. iron, manganese, fluorides etc., Low cost treatment, appropriate technology for water supply and sanitation, Compact system of treatment of surface and ground waters such as MB settlers, slow and sand filter, chlorine diffusion cartridge etc.

**UNIT-III (08 Hours)**

**Waste Water Treatment & Distribution:** Planning of distribution system in rural areas, Water supply during fairs, festivals and emergencies, Treatment and disposal of wastewater/sewage, various method of collection and disposal of night soil.

**UNIT-IV (07 Hours)**

**Onsite Sanitation System for Rural Areas:** On site sanitation system and Disposal of solids waste: Simple wastewater treatment system for rural areas and small communities such as stabilization ponds, septic tanks, soakage pits, surface drains, onsite sanitation systems etc., composting, land filling, Biogas plants.

**Recommended Text Books / Reference Books:**

1. Low cost on site sanitation option, Hoffman & Heijno Occasional Nov.1981 paper No. 21, P.O. Box 5500 2280 HM Rijswijk, the Netherlands offices, J.C. Mokeniaan
2. Rijswijk (the Haque), Wagner, E.G. and Lanoik, J.N. water supply for rural areas and Small communities, Geneva: W.H.O.1959.

3. Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New Delhi.
4. Water Supply and Pollution Control by Warren Viessman Jr. and Mark J. Hammer, 7th Edition 2005, Pearson Education.
5. Wastewater Engineering; Treatment, Disposal, Reuse, by Metcalf & Eddy,Tata McGraw-Hill.

## CONSTRUCTION PROJECT PLANNING & SYSTEMS

**Subject Code: BCIED1-621** **L T P C** **Duration: 30 Hrs.**

2 0 0 2

**Course Objectives:**

1. It includes-Integrated Pre-Construction Planning. Collaborative Commissioning. Complete Construction Project Life Cycle Management.
2. It provides necessary leadership, motivates employees to complete the difficult tasks well in time and extracts potential talents of its employees.

**Course Outcomes:**

1. Learn the structure of construction companies
2. Learn the management functions of construction companies
3. Practise contract management applications
4. Use project management applications
5. Plan construction projects
6. Gain information about construction risk analysis.

### UNIT-I (08 Hours)

**Introduction**: Need for project planning & management, time, activity & event, bar chart, Milestone chart, uses & draw backs.

**PERT Technology**: Construction of PERT network, time estimates, network analysis, forward pass & backward pass, slack, critical path, data reduction, suitability of PERT for research project.

### UNIT-II (08 Hours)

**CPM Technology**: Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance in project control.

### UNIT-III (07 Hours)

**Construction Equipment and Machinery**: Tractors, bull dozers, rippers, scrappers, power shovels, dragline, hoes and uses, factors affecting selection of equipment, economic life of equipment, maintenance and repair cost. Hoisting & Transporting Equipments: Hosts, Winches, Cranes, Belt conveyors, Ropeways, trucks & Wagons, Introduction to modern constructional equipments.

### UNIT-IV (07 Hours)

**Cost Analysis and Contract**: Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems, updating a project, planning of different components of civil engineering projects such as a house, workshop, dam, tunnel.

**Recommended Text Books / Reference Books:**

1. Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
2. National Building Code, Bureau of Indian Standards, New Delhi, 2017.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education
7. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications.

## BUILDING CONSTRUCTION PRACTICE

| Subject Code: BCIED1-622 | L | T | P | C | Duration: 30 Hrs. |
|---|---|---|---|---|---|
| | 2 | 0 | 0 | 2 | |

**Course Objectives:**

The students will get awareness about:

1. Various building construction techniques.
2. Various practices needed for different types of construction activities.
3. The students shall have a reasonable knowledge about the various procedures and the structural systems needed for construction of various types of structures from foundation to super structure.

**Course Outcomes:**

1. Identify the components of building and understand the impacts on materials.
2. Identify the factors to be considered in the construction of buildings and develop the construction practices and techniques.
3. Identify the practices for Sub Structure and Super Structure construction.
4. Identify the importance of sustainable development/construction approach.

**UNIT-I (07 Hours)**

**Structural Introduction** - Load Bearing Structure, Framed Structure, Load transfer mechanism, floor system, Development of construction techniques, High rise Building Technology, Seismic effect, Environmental impact of materials - Case studies on residential buildings, office buildings and other buildings in each zone.

**UNIT-II (08 Hours)**

**Building Construction Systems** - Specifications, details and sequence of activities and construction coordination, Site Clearance, Marking, Earthwork, masonry, stone masonry, Bond in masonry, concrete hollow block masonry, flooring, damp proof courses, construction joints, movement, and expansion joints, Building foundations Basements, temporary shed, centring and shuttering, slip forms, scaffoldings, de-shuttering forms, Fabrication and erection of steel trusses, frames, braced domes, laying brick, weather and water proof, roof finishes, acoustic and fire protection.

**UNIT-III (08 Hours)**

**Sub Structure Construction**- Techniques of Box jacking, Pipe Jacking, under water construction

of diaphragm walls and basement, Tunnelling techniques, Piling techniques, well and caisson, sinking cofferdam, cable anchoring and grouting, driving diaphragm walls, sheet piles, shoring for deep cutting, well points, Dewatering and stand by Plant equipment for underground open excavation.

**Super Structure Construction-** Launching girders, bridge decks, off shore platforms, special forms for shells, techniques for heavy decks, in-situ, pre-stressing in high rise structures, Material handling, erecting light weight components on tall structures, Support structure for heavy Equipment and conveyors, Erection of articulated structures, braced domes, and space decks.

**UNIT-IV (07 Hours)**

**Sustainable Construction Practices** - Sustainability in Construction, Waste Utilization as a Construction, Material, Use of green or biomaterials, Eco Building (Green Building & Material used), Construction methods, Natural Buildings, Passive buildings, Intelligent (Smart) buildings, Building automation, Energy efficient buildings for various zones, Role of Building Products in sustainability, Sustainability Assessment Methods.

**Recommended Text Books / Reference Books:**


1. Dr. B.C. Punmia, 'Building Construction', Laxmi Publications (P) Ltd., 2005.
2. S.S. Bhavikatti, 'Building Construction', Vikas Publishing House, 2012.
3. Charles J. Kibert, 'Sustainable Construction', John Wiley & Sons, 2012.
4. J. K. Yates and Daniel castro-Lacouture, 'Sustainability in Engineering Design and Construction', CRC Press, 2018.


## PAVEMENT DESIGN

| Subject Code: BCIED1-623 | L | T | P | C | Duration: 30 Hrs |
|---|---|---|---|---|---|
| | 2 | 0 | 0 | 2 | |

**Course Objectives:**

1. The objective of this course is to train the students about how to design the crust thickness of highway and airfield pavements.
2. To introduce and practice the design principles and methods of flexible and rigid pavements being used worldwide.
3. To give special emphasis on design methods prescribed by the Indian Roads Congress for flexible and rigid pavements in India
4. To acquaint the students about strengthening of existing pavement structures and some modern pavement design concepts.

**Course Outcomes:**

1. The students will learn about how to design the crust thickness of highway and airfield pavements.
2. They will learn the design principles and methods of flexible and rigid pavements being used worldwide.
3. They will learn in detail the design methods prescribed by the Indian Roads Congress for flexible and rigid pavements in India.

4. The students will get exposure to methodology of strengthening of existing pavement structures and some modern pavement design concepts.

**UNIT-I (07 Hours)**

**Introduction:** Desirable characteristics of pavement, types and components, difference between highway and airfield pavement, functions of pavement components, comparison between rigid and flexible pavement.

**Fundamentals of Design of Pavements:** design life, traffic factors, climatic factors, subgrade strength and drainage, stresses and deflections; Burmister's two layered analysis.

**UNIT-II (08 Hours)**

**Flexible Pavement Design Factors:** Design wheel load, contact pressure, ESWL concept, determination of ESWL by equivalent deflection criteria, stress criteria, soil subgrade strength using CBR value.

**Flexible Pavement Design Methods:** Group Index method, McLeod method, Kansas method, California Resistance Value method, IRC: 37-2018 method.

**UNIT-III (08 Hours)**

**Rigid Pavement Design:** Principles, factors - wheel load and its repetition, properties of sub grade, properties of concrete. Westergaard analysis – critical stresses, wheel load stresses, warping stress, frictional stress, and combined stresses.

**Design Methods of Rigid Pavements:** Design of cement concrete pavements by IRC:58-2015, PCA method, AASHTO method, reinforcement in slabs, requirements of joints, types of joints – expansion joint, contraction joint, warping joint, construction joint, longitudinal joint.

**UNIT-IV (07 Hours)**

**Strengthening of Existing Pavements:** Pavement overlays, types, design equations, flexible pavement overlay design as per IRC: 81-1997 using Benkelman beam.

**Modern Pavement Design Concepts:** Bituminous pavement with cemented base, interlocking concrete block pavement and roller compacted concrete pavement, full depth bituminous pavement, ultrathin white topping, perpetual pavement.

**Recommended Text Books / Reference Books:**

1. E.J. Yoder and M.W. Witczak, 'Principals of Pavement Design', Wiley Publication, New York.
2. S.K. Khanna and C.E.G. Justo, 'Highway Engineering', Nem Chand & Bros., Roorkee.
3. S.K. Sharma, 'Principles, Practice and Design of Highway Engineering', S. Chand & Co.
4. P. Chakraborty and A. Das, "Principles of Transportation Engineering", Prentice Hall India, New Delhi.
5. Yang H. Huang, 'Pavement Analysis and Design', Pearson Publishers.

| WATER & WASTEWATER TREATMENT | | | | | |
|---|---|---|---|---|---|
| **Subject Code: BCIED1-631** | **L** | **T** | **P** | **C** | **Duration: 45 Hrs** |
| | 3 | 0 | 0 | 3 | |

**Course Objectives:**

1. Inculcate the basic concepts of water treatment, its design and management.
2. Extensive knowledge of sources, conversion, distribution & maintenance of water supply system.
3. Modern low cost water treatment techniques for rural supply system.
4. Emphasizes on design criteria, design equations, kinetics and hydraulic diagrams for the design of unit operations and processes for wastewater treatment systems.
5. Deals with biological sludge handling and treatment.
6. Analyse the importance of rural sanitation systems and natural and constructed wetlands.

**Course Outcomes:**

1. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, welfare, and environmental factors.
2. An ability to develop and conduct appropriate experimentation, analyze and interpret data for future demand & supply.
3. Estimate sewage generation and design sewer system including Sewage pumping stations.
4. Required understanding on the characteristics and composition of sewage, self Purification of streams.
5. Perform basic design of the unit operations and processes for sewage treatment.

**UNIT-I (12 Hours)**

**Water treatment:** Water treatment schemes; Basic principles of water treatment; Design of Plain sedimentation, coagulation and flocculation, Filtration: design of slow, rapid and pressure filters; Disinfection units; Fundamentals of water softening, fluoridation and deflouridation, Water desalination and demineralization, taste and odour removal processes.

**UNIT-II (08 Hours)**

**Water Supply Systems:** Pipes for transporting water and their design, water distribution systems and appurtenances; Water supply network design and design of balancing and service reservoirs; operation and maintenance of water supply systems.

**Rural water supply:** Principles, selection of source, rain water harvesting, quantitative requirements, low cost treatment techniques.

**UNIT-III (15 Hours)**

**Treatment of Sewage:** Introduction to unit operations and processes - Primary treatment: screening (theory), grit chamber (theory and design), floatation units, sedimentation tanks(theory and design), Secondary treatment units: ASP (theory and design), Sequencing batch reactors (theory and design), Trickling filters (theory and design) Anaerobic systems; Anaerobic filters (theory), UASB (theory), Anaerobic lagoons (theory), Sludge Handling and disposal; thickening, stabilization, dewatering, drying and disposal.

**UNIT-IV (10 Hours)**

**Low Cost Sanitation Systems:** Imhoff tanks (theory and design), septic tank (theory and design), soakage pit/soil absorption systems; stabilization ponds (theory and design); oxidation ponds (theory and design); and constructed wetland systems.

**Wastewater Treatment Plants and Advanced Wastewater Treatment:** Treatment Plants; site selection, operation and maintenance aspects, Advanced wastewater treatment for nutrient removal, disinfection.

**Recommended Text Books / Reference Books:**

1. Environmental Engineering (Vol. I & II) by S.K. Garg, Khanna Publishers, Delhi.
2. Waste Water Engg. (Environmental Engg.-I & II) by B.C.Punmia, Ashok Jain, Laxmi Publications, New Delhi
3. Environmental Engg. - A design Approach by Arcadio P. Sincero and Gregoria P. Sincero, Prentice Hall of India, New Delhi
4. "Waste Water Engineering - Treatment and Reuse" by Metcalf & Eddy, TMH, New Delhi.
5. "Environmental Engg." By Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, McGraw Hill, International Edition

## GROUND IMPROVEMENT TECHNIQUES

| Subject Code: BCIED1-632 | L | T | P | C | Duration: 45 hrs. |
|---|---|---|---|---|---|
| | 3 | 0 | 0 | 3 | |

**Course Objectives:**

1. To understand the objectives, necessity and scope of ground improvement techniques
2. To learn different methods of in-situ densification of cohesive, cohesion-less soils
3. To learn the classification, functions and applications of Geo-synthetics in ground improvement
4. To learn the process of identification of necessity for ground improvement, finding alternative methods and recommendation of the ideal technique through case studies

**Course Outcomes:**

1. Ability to understand the necessity of ground improvement and potential of a ground for improvement
2. To gain comprehensive understanding about the improvement of in-situ cohesive soils as well as Cohesion less soils
3. Competence to analyse an in-situ ground, identification of ground improvement techniques feasible, selection of the ideal method, its planning , design, implementation and evaluation of improvement level

**UNIT-I (12 Hours)**

**General :** Formation of rock, soils and soil profiles, soil distribution in India and other countries - marine, black cotton soils (expansive)., lateritic, alluvial, desert soils peat etc., factors affecting the alteration of ground after formation – natural and man-made – reclaimed soils – methods of geotechnical processes.

**Compaction methods:** moisture density relations – compactive efforts – field methods – surface

compaction, deep compactions- vibro compaction methods, vibro-probes, stone columns, sand compaction, stone column piles, selection of methods – quality control – specifications for compaction process for solving field problems.

**UNIT-II (11 Hours)**

**Drainage methods:** seepage, ground water seepage control – filter requirements methods of dewatering – well point methods of discharge computations – design of steps for dewatering – design of well screens selection of pumps and accessories – deep bored wells. Pre-compression methods: compressibility and consolidation properties of soils estimation of rate of consolidation settlements – accelerating methods monitoring compressions – design of vertical drains – consolidation by electro osmosis and vacuum compression methods.

**UNIT-III (11 Hours)**

**Grouting and injection methods:** principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

**UNIT-IV (11 Hours)**

**Stabilization methods:** mechanical, cement, lime, chemical methods of stabilization of soils – use of admixtures – polymers – geo-synthesis –reinforcements thermal slurry trenches, void filling – pre-wetting –improving rock stability methods – exercise quality control to achieve desired results.

**Recommended Text Books / Reference Books:**

1. J.E. Bowles – Foundation Design &Analysis, McGraw-Hill Edition1995.
2. Ground improvement techniques by P. Purushottam Raj, Laxmi Publications, 1999.
3. F. S. Fang Handbook of Foundation Engg. CBS Pub., 1985.

## PAVEMENT CONSTRUCTION AND MANAGEMENT

**Subject Code: BCIED1-633** **L T P C** **Duration: 45 Hrs.**

3 0 0 3

**Course Objectives:**

1. The main objective of this course is to acquaint the students about various engineering methods used for construction and maintenance of different types of pavement structures.
2. To familiarize the students about the methods of evaluation of pavement structures to undertake various types of maintenance management strategies.
3. To introduce the concept of pavement management system and pavement performance prediction, which ensures timely maintenance of pavements with rational utilization of available budget

**Course Outcomes:**

1. The students will learn about various engineering methods used for construction and maintenance of different types of pavement structures.

2. The student shall get familiar with the methods of evaluation of pavement structures to undertake various types of maintenance management strategies.
3. They will learn the concept of pavement management system and pavement performance prediction, which will not only help them in field applications but also in research at the postgraduate level after completion of their graduation.

**UNIT-I (11 Hours)**

**Introduction:** Types of highway construction, materials for construction, construction procedure of different highways: Earth roads, Gravel roads, WBM roads, Bituminous pavements, Cement Concrete pavements. Equipment used for highway construction.

**Soil Stabilization for Pavements:** Principles of proportioning of soil-aggregate mixes and compaction, mechanical, soil-cement, soil-bitumen and soil-lime stabilization methods; construction control and quality control checks.

**UNIT-II (12 Hours)**

**Bituminous Pavement Construction:** Earthwork, compaction and construction of embankments, specifications of materials, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers.

**Cement Concrete Pavement Construction:** Specifications and method of cement concrete pavement construction; Quality control tests; Construction of various types of joints, Construction of interlocking block pavements.

**UNIT-III (11 Hours)**

**Pavement Maintenance:** Need for maintenance, Pavement failures, causes and remedial measures. Types of highway maintenance, Materials used for maintenance of different pavements, Maintenance and rehabilitation techniques.

**Pavement Evaluation:** Pavement distresses, functional condition evaluation of pavements-Roughness, Skid Resistance. Structural evaluation of pavements – non-destructive testing, Benkelman beam and Falling Weight Deflectometer.

**UNIT-IV (11 Hours)**

**Pavement Management Systems: Concept, c**omponents, structure, data requirements, Project level and Network level needs.

**Pavement Performance Prediction:** Modelling techniques – AASTHO, CRRI and HDM models, Budget forecasting for maintenance and rehabilitation, Ranking and optimization methodologies, life cycle costing.

**Recommended Text Books / Reference Books:**


1. S.K. Khanna and C.E.G. Justo, 'Highway Engineering', Nem Chand & Bros., Roorkee.
2. S.K. Sharma, 'Principles, Practice and Design of Highway Engineering', S. Chand & Co.
3. Ralph C. G. Haas, W. Ronald Hudson, 'Pavement Management Systems', McGraw-Hill Book Company.
4. M. Y. Shahin, 'Pavement Management for Airports, Roads, and Parking Lots' Kluwer Academic Publishers.


## EARTHQUAKE ENGINEERING

**Subject Code: BCIED1-634** | **L T P C** | **Duration: 45 Hrs.**

3 0 0 3

**Course Objectives:**

1. The primary objective of earthquake resistant design is to prevent building collapse during earthquakes thus minimizing the risk of death or injury to people in or around those buildings.
2. The potential consequences of strong earthquakes on urban areas and civil infrastructure.
3. Design, construct and maintain structures to perform at earthquake exposure up to the expectations and in compliance with building codes.

**Course Outcomes:**

1. The students will gain an experience in the implementation of Earthquake Engineering on engineering concepts which are applied in field Structural Engineering.
2. The students will get a diverse knowledge of earthquake engineering practices applied to real life problems.
3. The students will learn to understand the theoretical and practical aspects of earthquake engineering along with the planning and design aspects.

**UNIT-I (06 Hours)**

**Introduction to Earthquakes**: Causes of earthquakes, basic Terminology, Magnitude, Intensity, Peak ground motion parameters, Seismic Zoning Map of India, Seismograms and Accelerogram, Past earthquakes and Lessons learnt.

**UNIT-II (15 Hours)**

**Introduction to Dynamics**: Theory of Vibrations, Sources of Vibrations, Types of Vibrations, Degree of Freedom, spring action and damping, Single Degree of Freedom (SDOF) Systems – Formulation of equations of motion –Undamped and damped free vibration –Damping –Response to harmonic excitation –Concept of response spectrum. Multi-Degree of Freedom (MDOF) Systems: -Formulation of equations of motion –Free vibration –Determination of natural frequencies of vibration and mode shapes –Orthogonal properties of normal modes –Mode superposition method of obtaining response.

**UNIT-III (12 Hours)**

**Lateral Force analysis**- Lateral Strength, stiffness, ductility and structural configuration, Floor Diaphragm action, Moment resisting frames, shear walls.

**Codal Design Provisions**- Review of the latest Indian seismic code IS: 1893 (Part-I) provisions for buildings –Earthquake design philosophy.

**UNIT-IV (12 Hours)**

**Codal Detailing Provisions**- Review of the latest Indian Seismic codes IS: 4326 and IS: 13920 provisions for ductile detailing of R.C buildings –Beam, column and joints, Design of Shear walls as per IS: 13920 –Detailing of reinforcements.

**Recommended Text Books / Reference Books:**

1. Earthquake Resistant Design of Structures, Pankaj Aggrawal, Manish Shrikhande, PHI Learning
2. Dynamics of Structures: Theory and Applications to Earthquake Engineering, AK Chopra, Prentice Hall
3. Dynamics of Structures, R.W. Clough and Joseph Penzien, McGraw-Hill Education
4. Structural Dynamics by Mario & Paz, Springer.
5. Earthquake Resistant Design by David J. Dowrick, Wiley India Pvt Ltd
6. Elements of Earthquake Engg. by Jai Krishna, A.R. Chandrasekaran, Brijesh Chandra,
7. IS 1893: 2016 'Indian Standard Criteria for Earthquake Resistant Design of Structures'.
8. IS 4326: 1993 'Indian Standard for Earthquake Resistant Design and Construction of Buildings'
9. IS 13920:2016 'Ductile design and detailing of Reinforced Concrete Structures subjected to Seismic Forces'

**TRANSPORTATION ENGINEERING LAB**

| **Subject Code: BCIES1-605** | **L** | **T** | **P** | **C** | **Duration: 30 Hrs** |
|---|---|---|---|---|---|
| | 0 | 0 | 2 | 1 | |

**Course Objectives:**

1. The main objective of this course is to give practical exposure of laboratory testing of different kinds of highway construction materials such as Soil, Aggregate and Bitumen to check their suitability for their use in road construction.
2. The knowledge of these tests is very essential for a civil engineer to choose appropriate construction material to exercise better quality control in a road construction project.

**Course Outcomes:**

1. The student will learn the laboratory testing of different kinds of highway construction materials such as Soil, Aggregate and Bitumen.
2. The student will learn to check the suitability of highway construction material so as to exercise better quality control in a road construction project.

**Tests on Sub-Grade Soil:**

1. Proctor's Compaction Test
2. California Bearing Ratio Test

**Tests on Road Aggregates:**

1. Crushing Value Test
2. Los Angles Abrasion Value Test
3. Impact Value Test
4. Shape Test (Flakiness and Elongation Index)

**Tests on Bituminous Materials:**

1. Penetration Test
2. Ductility Test
3. Softening Point Test
4. Flash & Fire Point Test

**Recommended Books / Manuals:**

1. S.K. Khanna and C.E.G. Justo, 'Highway Material & Pavement Testing', Nem Chand and Brothers, Roorkee.
2. Ajay K. Duggal, Vijay P. Puri, 'Laboratory Manual in Highway Engineering', New Age Publications, New Delhi.

## COMPUTER-AIDED CIVIL ENGINEERING DRAWING LAB-II

| **Subject Code: BCIES1-606** | **L** | **T** | **P** | **C** | **Duration: 30 Hrs.** |
|---|---|---|---|---|---|
| | 0 | 0 | 2 | 1 | |

**Course Objectives:**

The students will be able to:

1. Develop structural designs.
2. Understand design procedures and ways- The student learn to interpret drawings, and to produce designs using Civil Engineering software.

**Course Outcomes:**

1. Design and draw working structural drawings of various concrete structures and their members.
2. Understand and interoperate design aids and handbooks.
3. Use of relevant Indian Standard specifications applicable to Reinforced concrete structures.

**Laboratory Drawing Works:**

1. Structural Drawings of Concrete elements such as Beams, Columns, Slabs, Stair, etc.
2. RCC framed structures.
3. Perspective view of one and two storey buildings.
4. Structural Drawings of Steel Elements such as Connections, Tension Members, Compression Members, Beams, Foundations, girders, etc.
5. Industrial buildings - North light roof structures – Trusses.