BME 301: Strength of Materials

Credits: 4
LTP 310

Course Description: The course aims to equip the students with the concepts of mechanical properties, stress & strain and the behavior of materials under different loading condition.

The course includes simple/ compound/ thermal stresses & strain, bending moment & shear force diagram, torsion in circular shafts, columns & struts, theory of bending stress and slope & deflection.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply concepts of strength of materials to obtain solutions to real time Engineering problems.

CO2: Draw and analyze shear force and bending moment diagram for different types of loading conditions.

CO3: Apply engineering principles to calculate the reactions, forces and moments.

Course Content

Unit I

Simple stresses and strains: Concept of stress and strain: St. Venants principle of stress and strain diagram, Hooke's law, Young's modulus, Poisson ratio, stress at a point, stresses and strains in bars subjected to axial loading, Modulus of elasticity, stress produced in compound subjected to axial loading, Temperature stress and strain calculations due to applications of axial loads and variation of temperature in single and compound walls.

Unit II

Compound stresses and strains: Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications, Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain, Relationship between elastic constants.

Unit III

Bending moment and shear force diagrams: Bending moment and shear force diagrams, SF and BM definitions. BM and SF diagrams for cantilevers, simply supported and fixed beams with or without overhangs and calculation of maximum BM and SF and the point of contra flexure under Concentrated loads, Uniformity distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Unit IV

Theory of bending stresses: Assumptions in the simple bending theory, derivation of formula: its application to beams of rectangular, circular and channel sections, composite/fletched beams, bending and shear stresses in composite beams. Unsymmetrical Bending, Combined bending and torsion, bending and axial loads etc.

Unit V

Torsion: Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion.

Unit VI

Columns and struts: Columns under uni-axial load, Buckling of Columns, Slenderness ratio and conditions. Derivations of Euler's formula for elastic buckling load, equivalent length, Rankine Gordon's empirical formula.

Unit VII

Slope and deflection: Relationship between moment, slope and deflection; method of integration, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following: a) Cantilevers b) Simply supported beams with or without overhang c) Under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads.

Recommended Books / Suggested Readings:

1. Strength of Materials, Pytel A H and Singer F L, Latest Edition, Harper Collins, New Delhi (2010).
2. Mechanics of Materials, Beer P F and Johnston (Jr) E R, SI Version, Tata McGraw Hill, India (2017).
3. Engineering Mechanics of Solids, Popov E P, SI Version 2nd Edition, Prentice Hall of India, New Delhi (2003).
4. Elements of Strength of Materials, Timoshenko S P and Young D H, 5th Edition, East West Press, New Delhi (2012).
5. Strength of Materials R.S Lehri and A.S. Lehri, Kataria and Sons.
6. Strength of Materials R.K.Rajput, , Laxmi Publication
7. Strength of Materials S. Ramamrutham, Dhanpat Rai & Sons.

BCE301: FLUID MECHANICS AND HYDRAULIC
Credits:4
LTP 310

Course Description: The course aims to equip the students with understanding of the behavior of fluids at rest or in motion, analytical abilities related to fluid flow.

The course includes fundamental of fluid mechanics, fluid kinematics, fluid dynamics, hydraulics jump and surges, flow through pipes, pressure and flow measurement.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply conservation laws to derive governing equations of fluid flows

CO2: Compute hydrostatic and hydrodynamic forces

CO3: Analyze and design simple pipe systems

Course Content:

Unit I

Fundamentals of Fluid Mechanics: The Concept of a Fluid, the Fluid as a Continuum, Dimensions and Units, Properties of fluid, Thermodynamic Properties of a Fluid, Viscosity and other Secondary Properties, Fluid Statics: Pascal law and its applications, Hydrostatic Pressure Distributions, Application to Manometer, Hydrostatic Forces on Plane Surfaces, Hydrostatic Forces on Curved Surfaces, Hydrostatic Forces in Layered Fluids, Buoyancy and Stability, Pressure Distribution in Rigid-Body Motion.

Unit II

Fluid Kinematics: Classification of fluid flows. Lagrangian and Euler flow descriptions. Velocity and acceleration of fluid particle. Local and convective acceleration. Normal and tangential acceleration. Path line, streak line, streamline and timelines. Flow rate and discharge mean velocity. One dimensional continuity equation. Continuity equation in Cartesian (x,y,z), polar (r,θ) and cylindrical (r,θ,z) coordinates. Derivation of continuity equation using the Lagrangian method in Cartesian coordinates. Rotational flows: rotation, vorticity and circulation. Stream function and velocity potential function, and relationship between them. Flow net. Fluid Dynamics: Derivation of Euler's equation of motion in Cartesian coordinates, and along a streamline. Derivation of Bernoulli's equation (using principle of conservation of energy and equation of motion) and its applications to steady state ideal and real fluid flows.

Unit III

Hydraulic Jump and Surges: Theory of Jump, Elements of jump in a rectangular Channel, length and height of jump, location of jump, Energy dissipation and other uses, Positive and negative surges. Design of Hydraulic Structures: Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage and weir. Use of hydraulic jump in energy dissipation, Types of energy dissipaters and their hydraulic design.

Unit IV

Flow Through Pipes: Laminar and Turbulent Flows: Reynolds number, critical velocity, critical Reynolds number, hydraulic diameter, flow regimes. Hagen – Poiseuille equation. Darcy equation. Head losses in pipes and pipe fittings. Flow through pipes in series and parallel .Concept of equivalent pipe. Roughness in pipes. Pressure and Flow Measurement: Manometers. Pitot tubes.Various hydraulic coefficients.Orifice meters. Venturi meters. Borda mouthpieces. Notches (rectangular, V and Trapezoidal) and weirs.Rotameters.

Recommended Books / Suggested Readings:

1. Fluid Mechanics and Fluid Power Engineering by Kumar D S, 6th Edition SK Kataria and Sons, Delhi (1998).
2. Introduction to Fluid Mechanics by Fay J A, "", Prentice Hall of India Private Limited, New Delhi (1996).
3. A text book of Fluid mechanics and Hydraulic Machines by Bansal R K, 8th Edition, Laxmi Publications (P) Ltd. New Delhi (2002).
4. Fluid Mechanics: Fundamentals and Applications by Yunus Cengel & John Cimbala,"", 2ndreprint 2007, Tata McGraw Hill, New Delhi
5. Fluid Mechanics by F M White, , 6th ed., McGraw Hill, New York
6. Fluid Mechanics by Som &Biswas, Tata-McGraw Hill, New York.

BCE302: BUILDING MATERIAL & CONSTRUCTION
Credits: 3
LTP 300

Course Description: The course aims to equip the students with knowledge of various structural materials, manufacturing processes and application methods

The course includes Building Stones & Bricks, Cement, Concrete, Timber, Miscellaneous Materials, Foundation and walls, brick and stone masonry, Plastering and pointing, floors.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Test all the concrete materials as per IS code.

CO2: Design the concrete mix using IS code recommendations.

CO3: Determine the properties of fresh and hardened concrete.

CO4: Design different types of concrete and their applications.

CO5: Ensure quality control while testing/ sampling and acceptance criteria.

Course Content

Unit I

Building Stones & Bricks: General, Characteristics of a good building stone, Deterioration and preservation of stones, Artificial Stones, Composition of good brick earth, Qualities of good bricks, Classification of bricks, Tests on bricks, and Varieties of firebricks. Cement: Composition of cement, Raw Materials, Manufacturing process, Varieties of cement, Hydration of cement, Properties, testing of cement.

Unit II

Concrete: Introduction, Constituents of concrete, batching of materials, Manufacturing process of cement concrete, workability and factors affecting it, Methods to determine workability, segregation and bleeding of concrete, Strength of concrete and factors affecting it, Ready Mix Concrete(RMC). Timber: Structure of a tree, classification of trees, Defects in timber, Qualities of a good Timber, seasoning of timber, Decay of timber, Preservation of timber.

Unit III

Miscellaneous materials: Paints, Distempering, Glass, Plastics. Foundation and Walls: Definition, types of foundations, causes of failures of foundation and remedial measures, Types of walls and thickness considerations. Brick and stone masonry: Terms used, Types of bonds & their merits and demerits, rubble and ashlar joints in stone masonry, cement concrete hollow blocks and their advantages and disadvantage.

Unit IV

Plastering and pointing: Objects, Methods of plastering, Materials and types, Defects in Plastering, Special material for plastered surface, distempering white washing and colour washing. Floors: General, Types of floors used in building & and their suitability, factors for selecting suitable floor for building. Miscellaneous topics: Building Services – Plumbing service, Electrical services, Air Conditioning, Acoustics and sound insulation, Fire protection measures, lift.

Recommended Books / Suggested Readings:

1. Rangwala S C, "Engineering materials" Charotar Publishing House, Anand, 2000.
2. Ghose D N, "Materials of Construction" Tata McGraw Hill, New Delhi, 2003.
3. Varghese, "Building Materials" Prentice Hall of India, New Delhi. 2005.
4. Bindra & Arora, "Building Construction" Dhanpat Rai Publications (P) Ltd, New Delhi, 2003.
5. Sinha S K and Jha J, "Building Construction" Khanna Publishers, New Delhi, 2001
6. Rangawala S C, "Building Construction" Charotar Publishing House, Anand, 1993.
7. Ghose D N, "Materials of Construction" Tata McGraw Hill, New Delhi, 2003.

BME321: Strength of Materials Laboratory
Credits: 1
LTP 002

Course Description: The course aims to equip the students with the experience of material testing procedures.

The course includes measuring strength, hardness, toughness and fatigue of material.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Perform various tests on UTM machine.

CO2: Calculate the torsion strength of materials.

CO3: Calculate the impact strength of the materials.

List of Practical

1. Draw Stress Strain curve for Ductile and Brittle material in tension.
2. Draw Stress Strain curve for Ductile and Brittle material in compression.
3. Draw shear stress, shear strain curve for ductile and brittle material in torsion strength testing
4. Draw load deflection curve for spring in loading and unloading conditions.
5. To determine the hardness of the given material by Rockwell and Brinell hardness testing machine.
6. To determine the fatigue strength of the material.
7. To determine the impact strength by Izod and Charpy test.

BCE321: FLUID MECHANICS AND HYDRAULICS LABORATORY
Credits: 1
LTP 002

Course Description: The course aims to equip the students with knowledge of the behavior of fluids at rest or in motion and to develop analytical abilities related to fluid flow.

The course includes determination of fluid properties through tests.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply conservation laws to derive governing equations of fluid flows.

CO2: Compute hydrostatic and hydrodynamic forces

CO3: analyze and design simple pipe system.

LIST OF PRACTICAL:

1. To determine the metacentric height of a ship model.
2. To verify Bernoulli's theorem.
3. To calibrate a venturimeter and to determine its coefficient of discharge.
4. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number.
5. To study the flow over v notch (weir) and to find the coefficient of discharge.
6. To determine the hydraulic coefficient of discharge of a mouth piece.
7. To determine the coefficient of friction of pipes of different diameters.
8. To determine the head loss in a pipe line due to sudden expansion / sudden contraction/ bend.
9. To determine the velocity distribution for pipe line flow with a pitot static probe.

BCE322: Computer-aided Civil Engineering Drawing
Credits : 2
LTP 004

Course Description: The course aims to equip the students with graphical skills for communicating concepts, ideas and designs of engineering products graphically/ visually as well as understand another person's designs and exposure to national standards relating to technical drawings using Computer Aided Design and Drafting practice.

The course includes introduction, symbols and sign conventions, masonry bonds, Building drawing, and pictorial view.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Develop Parametric design and the conventions of formal engineering drawing

CO2: Produce and interpret 2D & 3D drawings

CO3: Communicate a design idea/concept graphically/ visually

CO4: Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software

CO5: Get a Detailed study of an engineering artifact

Course Content

Unit I

Introduction; Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, coordinate systems, reference planes. Commands: Initial settings, drawing aids, drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards

Unit II

Symbols and sign conventions: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards.

Unit III

Masonry bonds: English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall. Pictorial view: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM) It may be advisable to conduct Theory sessions along with Lab demonstrations.

Unit IV

Building drawing: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity.

List of Drawing Experiments:

1. Buildings with load bearing walls including details of doors and windows.
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out a description of the Facility in about 500 -700 words.
3. RCC framed structures
4. Reinforcement drawings for typical slabs, beams, columns and spread footings.
5. Industrial buildings - North light roof structures - Trusses
6. Perspective view of one and two storey buildings

Recommended Books / Suggested Readings:

1. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
2. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
3. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
5. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
6. (Corresponding set of) CAD Software Theory and User Manuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons.

BMC 002: Constitution of India

Credits: 0

LTP 200

Course Description: The course aims to equip the students with the fundamental rights, duties and directive principles of state policy. The course includes the concepts of State and Union Government and its administration, role of constitution in democratic society.

Course Outcomes (CLO):

Upon successful completion of the course, the students should be able to:

CO1: Have general knowledge and legal literacy and thereby to take up competitive examinations

CO2: Understand state and central policies, fundamental duties

CO3: Understand Electoral Process, special provisions

CO4: Understand powers and functions of Municipalities, Panchayats and Co-operative Societies

Course Content:

Unit I

Introduction: Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

Unit II

Union Government and its Administration: Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

Unit III

State Government and its Administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Unit IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Unit V

Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Recommended Books / Suggested Readings:

1. Laxmikanth, Indian Polity, McGraw Hill, 5th edition.
2. Kashyap Subhash, Indian Administration
3. Basu D.D., Indian Constitution
4. Avasthi and Avasthi, Indian Administration, Lakshmi Narain Agarwal

BCE300: SUMMER TRAINING
Credits: S/US
LTP 000

Course Description: The course aims to equip the students with the skills of basic engineering practice.

Upon successful completion of the course, the students should be able to:

CO1: To acquire skills in basic engineering practice.

CO2: Identify the hand tools and instruments.

CO3: Gain measuring skills.

CO4: Obtain practical skills in the trades.

Summer Workshop Training will be imparted in the University at the end of 2nd semester for Four (04) weeks duration (Minimum 36 hours per week). Industrial tour will also form a part of this training.

BCE401: Engineering Surveying
Credits: 3
LTP 300

Course Description: The course aims to equip the students with fundamental principles of surveying fundamental principles of surveying, hands-on training to different surveying methods and related Instruments, the use of field book for different Survey.

The course includes introduction, chain and compass surveying, plan table surveying, levelling and contouring, and theodolite traversing.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Use conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling.

CO2: Apply the techniques involved in fieldwork and to work as a surveying team.

CO3: Plan a survey appropriately with all the required skills to understand the surroundings.

CO4: Take accurate measurements, use field book appropriately and adjust of errors.

CO5: Plot traverses / sides of building and determine the location of points present on field on a piece of paper.

Course Content

Unit I

Introduction: Basic definition, classification and principles of surveying, Importance of surveying to engineers, Surveying measurements and errors. Chain and Compass Surveying: Measurement of distances with chain and tape, direct & indirect ranging, offsets, bearing and its measurement with prismatic compass, calculation of angles from bearings.

Unit II

Plane Table Surveying: Setting up the plane table and methods of plane tabling.

Unit III

Levelling & Contouring: Setting up a dumpy level, booking and reducing the levels by rise & fall method and height of instrument method, correction due to curvature and refraction, characteristics of contours, methods of contouring, uses of contour maps.

Unit IV

Theodolite Traversing: Temporary and permanent adjustments, measurement of horizontal and vertical angles, adjustment of closing error by Bowditch & Transit rules.

Recommended Books / Suggested Readings:

1. Surveying, by Agor, R., Khanna Publishers (1982)
2. Surveying & Levelling by Bhavikatti,S.S. Volume I&II (2009)
3. Surveying Vol I & II, by Duggal, S.K., Tata McGraw Hill (2006)
4. Surveying Vol. I and II by Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, , Laxmi Publications (2005

BCE402: STRUCTURAL ANALYSIS
Credits: 4
LTP 310

Course Description: The course aims to equip the students with structural framework and load transfer mechanism, static and kinematic indeterminacy for beams, trusses and building frames and the concepts of deflection and bending in structural design.

The course includes Structural analysis, Moving Loads, Arches, and Bending unsymmetrical.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Use various classical methods for analysis of indeterminate structures.

CO2: Determine the effect of support settlements for indeterminate structures

CO3: Apply the concepts of ILD and moving loads on determinate structures.

Course Content

Unit I

Structural analysis: Classification of Structures, Types of structural frameworks and Load Transfer Mechanisms, stress resultants, degrees of freedom per node, Static and Kinematic Indeterminacy for beams, trusses and building frames. Classification of Pin jointed determinate trusses, Analysis of determinate plane and space trusses (compound and complex). Method of Substitution and Method of tension coefficient.

Unit II

Moving Loads: Rolling loads and influence line diagrams for beams and trusses, Absolute maximum bending moment and shear force. Muller-Breslau's principal & its applications for determinate structures.

Unit III

Arches: Types of Arches, Analysis of Arches, Linear arch, Eddy's theorem, Analysis of three hinged parabolic arch, spandrel-braced arch, moving load & influence lines for three hinged arch. Deflection: Strain Energy of deformable systems, Maxwell's reciprocal & Betti's theorem, Castigliano's first theorem, Calculations of deflections: Moment area method, unit load method & Conjugate beam methods for statically determinate beams truss and frames.

Unit IV

Bending unsymmetrical bending in beams, location of neutral axis, computation of stresses and deflection, Shear Centre its location for common structural sections. Bending of curved bars in plane of bending, stresses in bars of small & large initial curvatures.

Recommended Books / Suggested Readings:

1. Structural Analysis by Hibbler , Pearson Education.
2. Analysis of Structures by T S Thandavmorthy , Oxford University Press.
3. Elementary Structural Analysis by Wilbur and Norris, Tata McGraw Hill.
4. Basic Structural Analysis by Reddy,C.S., Tata McGraw Hill.
5. Theory & Analysis of Structures by Jain,O.P.and Jain, B.K. Vol.I & II Nem Chand.
6. Analysis of Strcutures by Vazirani & Ratwani et al , Khanna Publishers

BCE403: IRRIGATION ENGINEERING
Credits: 4
LTP 310

Course Description: The course aims to equip the students with the problems involved with Irrigation Engg.- socio Economic, various types & requirements of irrigation, soil moisture relationship Crop patterns, and Water conveyance systems – canals & allied structures.

The course includes Introduction of Irrigation Engineering, water Requirements of crops, design of channels, Losses in canals, water logging and drainage, Tube- Well Irrigation and River Training works.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Assess the irrigation needs of crops.

CO2: Design weirs on pervious foundation.

CO3: Design gravity dam and earthen dam.

CO4: Select and design canal fall.

Course Content

Unit I

Introduction: Importance of Irrigation Engineering, purposes of Irrigation, Objectives of Irrigation, Benefits of Irrigation, Advantages and disadvantages of irrigation, Types and methods of irrigation. Water Requirements of Crops: Factors affecting water requirement, consumptive use of water, water depth or delta, Duty of water, Base Period, relation between delta, duty and base period, Soil crop relation-ship and soil fertility.

Unit II

Design of Channels: Classifications of canals, canal alignment, Inundation canals, Bandhara irrigation, advantages and disadvantages, Silt Theories-Kennedy's theory, Lacey's theory, Drawbacks, comparison & Design of unlined canals based on Kennedy & Lacey's theories. Types of lining, selection & maintenance of lined canals, silt removal, strengthening of channel banks. 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.

Unit III

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, Limitations of Theim's and Dupuit's formulae. Interference of tube wells with canal or adjoining tube-wells, causes of failure of tubewells, optimum capacity, Duty and delta of a tube well.

Unit III

River Training Works: Objectives, classification of river-training works, Design of Guide Banks. Groynes 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.

Recommended Books / Suggested Readings:

1. Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers
2. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
3. Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, . Katson Publishing
4. Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
5. P.N. Modi. Irrigation with Resources and with Power Engineering, Standard Book House
6. Irrigation Engg. Vol. I & II by Ivan E. Houk, John Wiley and sons.

BTM301: TRANSFORM AND DISCRETE MATHEMATICS
Credits: 4
LTP 310

Course Description: The course aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. It also familiarize the prospective engineers with transformation equations and discrete structures.

Course includes transform calculus, sets, relations and functions, propositional logic, algebraic structures and basic counting techniques.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Use the mathematical tools needed in evaluating multiple integrals and their usage.

CO2: Implement the effective mathematical tools for the solutions of differential equations that model physical processes.

CO3: Use the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Content:

Unit I

Transform Calculus -1: Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, Application of linear transformation on circuits.

Unit II

Transform Calculus II: Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.

Unit III

Sets, relations and functions: Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses.

Unit IV

Propositional Logic: Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory.

Partially ordered sets: Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. Boolean and pseudo Boolean lattices.

Unit V

Algebraic Structures: Algebraic structures with one binary operation – semigroup, monoid and group Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. (Definitions and simple examples only).

Algebraic structures with two binary operations ring, integral domain, and field. Boolean algebra and Boolean ring (Definitions and simple examples only).

Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions.

Introduction to Graphs: Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Recommended Books / Suggested Readings:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
3. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
4. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
5. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
6. K. H. Rosen, Discrete Mathematics and its Applications, 6th Ed., Tata McGraw-Hill, 2007.
7. J. L. Hein, Discrete Structures, Logic, and Computability, 3rd Ed., Jones and Bartlett, 2010.
8. N. Deo, Graph Theory, Prentice Hall of India, 1974.
9. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
10. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
11. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
12. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

HVE001: HUMAN VALUES AND PROFESSIONAL ETHICS
Credits: 3
LTP 300

Course Description: The course aims to help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings. Also, to facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. It also aims to highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with nature.

Course includes introduction of need, basic guidelines and content, process for value education, understanding harmony in the human being, harmony in myself, understanding harmony in the family and society, harmony in human and human relationship

Course Outcomes:

Upon successful completion of the course, the students should be able to:

CO1: Recognize importance of human values, harmony and ethical behaviour in real life situations.

CO2: Understand the fundamental concept of human value

CO3: Apply basic concept of harmony in his life.

Course Content:

Unit I

Introduction –Need, Basic Guidelines and Content: Understanding the need, basic guidelines, content and process for value Education, Self -Exploration – What is it? – Its content and process: 'Natural Acceptance' and Experiential Validation – as the mechanism for self-explanation, Continuous Happiness and Prosperity – A look at basic Human Aspirations.

Unit II

Process for Value Education: Right Understanding, Relationship and Physical Facilities – basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations; understanding and living in harmony at various levels.

Unit III

Understanding Harmony in the Human Being: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' – Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).

Unit IV

Harmony in Myself: Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya: correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya – practice exercises and Case Studies will be taken up in Practice Sessions

Unit V

Understanding Harmony in the Family and Society – harmony in Human - Human Relationship: Understanding harmony in the family – the basic unit of human interaction, Understanding values in human relationship; meaning of Nyaya and Program for its fulfillment to ensure Ubhay-tripti, Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.

Recommended Books / Suggested Readings:

1. R R Gaur, R,Sangal, G.P Bagaria, 2009, A Foundation Course in value Education(English)
2. R R Gaur, R Sangal G P Bagaria, 2009, Teacher's Manual (English)
3. Subhas Palekar, 2000, How to practice natural Farming, Pracheen (Vaidik) Krishi tantra shodh, Amravati
4. Ivan IIIich, 1974, Energy& Equity, The Trinity Press, Worcester, and harper Collins, USA
5. E.F. Schumacher, 1973, small is Beautiful; a study of economics as if people mattered,Blond & Briggs, Bratain
6. Sussan George, 1076, How the other half Dies, Penguin Press, Peprinted 1986, 1991
7. PL Dhar, RR Gaur, 1990, Science and Humanism, common wealth publishers
8. A.N. Tripathy, 2003, Human values, New Age International Publisher
9. Donella H. Meadows, Dennis L. Meadows,Jorgen Randers, William W. Behrens III,1972,
10. Limits to Growth – club of Rome's report, universe Books
11. E.G. Seebauer & Robert, L BERRY, 2000, Foundationals of Ethics for Scientists & Engineers, Oxford UniversityPress
12. M. Govindrajran, S Natrajan & V.S. Senthi Kumar, Engineering Ethics (including human Values), Eastern Economy Edition, Prentice hall of India Ltd
13. B P Banerjee, 2005, Foundations of Ethics and Management, Excel books
14. B.L. Bajpai, 2004, Indian Ethos and Modern Management , New Royal book Co; Lucknow, Reprinted 2008.

BCE421: Engineering Surveying Laboratory
Credits: 2
LTP 004

Course Description: The course aims to equip the students with the knowledge of fundamental principles of surveying, hands-on training to different surveying methods and related Instruments, the use of field book for different Survey, and hands-on training about the use of different survey equipment.

The course includes plotting map using surveying techniques.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Use conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling.

CO2: Apply the techniques involved in fieldwork and to work as a surveying team.

CO3: Plan a survey appropriately with all the required skills to understand the surroundings

CO4: Take accurate measurements, use field book appropriately and adjust of errors.

CO5: Use electronic Survey instruments.

List of experiments:

1. Measurement of distance, ranging a line.
2. Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
3. Different methods of leveling, height of instrument, rise & fall methods.
4. Measurement of horizontal and vertical angle by theodolite.
5. Determination of tachometric constants and determination of reduced levels by tachometric observations.
6. Plane table survey, different methods of plotting, two point & three-point problem.
7. Determination of height of an inaccessible object.
8. Setting out a transition curve. Setting out of circular curves in the field using different methods.
9. Plotting of traverse using Total Station and GPS.

BCE422: STRUCTURAL ANALYSIS LABORATRY
Credits: 1
LTP 002

Course Description: The course aims to equip the students with structural framework and load transfer mechanism, static and kinematic indeterminacy for beams, trusses and building frames, the concepts of deflection and bending in structural design.

The course includes analysis of various structure using structural packages.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Use various classical methods for analysis of indeterminate structures.

CO2: Determine the effect of support settlements for indeterminate structures.

CO3: Apply the concepts of ILD and moving loads on determinate structures.

CO4: Determine the reversal of stresses in trusses using ILD.

List of experiments:

1. Verification of Shear Force and Bending Moment Diagrams for Beams using standard structural analysis package i.e. Autodesk Robot Structural Analysis.
2. Verification of Maxwell's reciprocal theorem.
3. Determination of Curved Beam.
4. Study of Two Hinge arch.
5. Study of Three Hinge Arch.
6. Study of Pin jointed truss.
7. To verify strain in an externally loaded beam with the help of strain gauge indicator.

BCE501: SOIL MECHANICS
Credits: 4
LTP 310

Course Description: The course aims to equip the students with understanding the Properties of the soil and study the parameter of it.

The course includes fundamental of soil mechanics, Soil properties, Permeability and seepage, Stresses in soils, Compaction and Shear strength

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Carry out soil classification.

CO2: Solve three phase system problems.

CO3: Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.

CO4: Estimate the stresses under any system of foundation loads.

CO5: Solve practical problems related to consolidation settlement and time rate of settlement.

Course Content

UNIT I

Introduction: Definition of soil, rock, soil mechanics and foundation engineering, soil formation, soil structure, soil map of India, classification of soils. Soil properties: Basic definitions, phase diagram, water content, specific gravity, void ratio, porosity, unit weight, weight volume relationships, index properties of soil and their determination, degree of saturation, density index.

UNIT II

Permeability and seepage: Darcy's law and its validity, seepage velocity, discharge velocity, constant and variable head permeable- meter, pumping in and out tests, permeability of stratified soils, factors affecting permeability, Laplace's equation, flow potential flow net and its properties, different methods of drawing flow nets, seepage pressure, quick sand, exit gradient, piping, design of filter, principle of total and effective stresses, capillarity conditions in soil, effective and pore pressures.

UNIT III

Stresses in soils: Need for finding stress distribution in soil, assumptions in elastic theories, Boussinesq's equation for point, line, circular and rectangular loads, Westergaad's formula for point load, comparison of Boussinesq's and Westergaard's equation, concept and use of pressure bulbs, principle and use of New mark's influence chart, contact pressure.

UNIT IV

Compaction: Mechanism of compaction, objective of compaction, measurement of compaction, factors affecting compaction, optimum moisture content, Standarad Proctor test, Modified Proctor test, effect of moisture content and compactive effort on dry density, zero air void curve, compaction of cohesionless soils, field compaction, field control of compaction. Shear strength: Normal, shear and principal stresses, Columb's equation, Mohr's stress circle, Mohr-Columb failure criteria, laboratory determination of shear parameters of soil by direct shear tests, triaxial test, unconfined compression test, Vane shear test, Consolidated drained, consolidated undrained and unconsolidated undrained shear test, pore pressure parameters, Lambe's p-q diagram.

Recommended Books / Suggested Readings:

1. Soil Mech. & Foundation Engg, by K.R.Arora, Standard Publishers Distributors
2. Geotechnical Engineering, by P. Purshotama Raj
3. Soil Mech. & Foundation Engg., by V.N.S.Murthy
4. Principle of Foundation Engineering by B.M.Das, CL Engineering
5. Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International
6. Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
7. Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education
8. Foundation Engineering by Varghese P.C, PHI Learning.
9. Problems in Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publication.
10. Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education

BCE502: Design of Concrete Structures
Credits 4
LTP 310

Course Description: The course aims to equip the students with understanding of reinforced cement concrete, properties and design of structural elements like slab, beam, column and footing as per Indian standard codes

The course includes Properties and testing of concrete, Limit state design method, Design of Reinforced Beams, Design of Slab, Design of Columns.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the fundamental concepts of working stress method and limit state method.

CO2: Use IS code of practice for the design of concrete elements.

CO3: Design the beam, slab, stairs, column and footing.

CO4: Draw various R.C.C. structural elements.

CO5: Design masonry structures.

Course Content

UNIT I

Properties and testing of concrete: Concrete making materials, mix design, Properties of concrete and reinforcements, testing of concrete, Non-destructive testing of concrete Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress Method.

UNIT II

Limit state design method: Assumptions in Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams by Limit State Design Method.

UNIT III

Design of Reinforced Beams: Behaviour of RC beam in Shear, Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, design of beam in shear, Introduction to development length, Anchorage bond, and flexural bond. (Detailed Examples by Limit State Design Method), Failure of beam under shear, Concept of Equivalent Shear and Moments.

UNIT IV

Design of Slabs: Design of one way and two-way solid slabs by Limit State Design Method, Serviceability Limit States, Control of deflection, cracking and vibrations. Design of Columns: Design of Columns by Limit State Design Method-Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uni-axial bending, Design of columns under bi-axial loading by Design Charts. 8

Note: All designs shall be conforming to IS: 456 – 2000.

Recommended Books / Suggested Readings:

1. Concrete Technology by Gambhir M.L, Tata McGraw Hill, Second, 1995.
2. RCC Theory and Design by Shah M.G., Kale.C.M. Macmillan India Ltd. 1987.
3. Prestressed Concrete by N. Krishnaraju., Tata McGraw Hill, (Third Edition) 198.
4. Concrete Technology by M.S.Shetty, S.Chand and Company New Delhi, 2005.
5. Concrete Technology -Vol I Orchard D.F.Applied Science Publishers (Fourth Edition) 1979.
6. Properties of Concrete by Neville A.M and J.J.Brook. Addison Wesley 1999.
7. Design of prestressed concrete structures by Lin T.Y,Burns N.H. John Wiley and sons. (Third Edition).1982.
8. Reinforced Concrete Design by S. Ramamurtham Dhanpat Rai Publications 2009

BCE503: TRANSPORTATION ENGINEERING
Credits 3
LTP300

Course Description: The course aims to equip the students with transportation, traffic engineering importance of Highway Drainage, Maintenance, safety and control measures.

The course includes Development and Planning, Highway Materials, Geometric Design, Highway Drainage and Maintenance and Traffic Engineering.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Carry out surveys involved in planning and highway alignment

CO2: Design cross section elements, sight distance, horizontal and vertical alignment

CO3: Implement traffic studies, traffic regulations and control, and intersection design

CO4: Determine the characteristics of pavement materials

CO5: Design flexible and rigid pavements as per IRC

Course Content

UNIT I

Introduction: Fundamentals of Transportation System, spatial significance of transportation system, impact on life style, components of the system, Transportation Scenario in India, Five year plans, privatization Efforts, Multilateral funding, Modern Transportation. Development and Planning: Road transport Characteristics, Classification of roads, development plans, network patterns, data collection and surveys, principles of alignment, evaluation of plan proposals.

UNIT II

Highway Materials: Sub grade Soil – AASHO Classification, group Index, Sub grade soil Stabilization. CBR, aggregate Physical and Mechanical properties and tests-Bituminous materials classification sources properties and tests. Cutback and Emulsions, modified Bitumen IRC/IS Standards, Introduction to Geotextiles. Construction and Maintenance: IRC, MOST specifications for quality and quantity of materials, techniques, tools and plant, for the Earthwork, sub base, base and wearing / surfacing course of flexible pavements with gravel, W.B.M., WMM, stabilized Bituminous and concrete as Construction material.

UNIT III

Geometric Design: Road, road user and road vehicle characteristics, Factors affecting design standards. Cross Section elements, stopping and overtaking sight distance overtaking zones. Horizontal alignment- Curves, design of super elevation, widening, 'transition curves, vertical alignments, Design of summit and Valley Curves, I.R.C. standards for Geometric Design, Geometrics of Hill Roads. Pavement Design: Types of pavements and characteristic, Design parameters, Axle and Wheel load, tyre pressure, ESWL for dual Wheels, repetitions, Group Index and CBR method of flexible pavement design. Analysis of load and temperature stresses for rigid pavement, joints.

UNIT IV

Highway Drainage and Maintenance: Importance of drainage and maintenance, Surface Drainage and Subsoil Drainage, Construction in Water-logged areas, Pavement Failures, Pavement Evaluation, Maintenance and Strengthening Measures.Traffic Engineering: 3E's of, traffic characteristics, Surveys, Intersection-types, layouts, design principles, Urban traffic, parking, lighting, Accidents, Traffic control Devices-marking, Signs, Signals, Regulations Motor Vehicle Act and Rules. Traffic Characteristics: Road User Characteristics, Driver Characteristics, Vehicular Characteristics. Traffic Studies: Volume Studies, Speed Studies, O-D Survey, Parking Study. Traffic Safety and Control Measures: Traffic Signs, Markings, Islands, Signals, Cause and Type of Accidents, Use of Intelligent Transport System

Recommended Books / Suggested Readings:

1. Highway Engineering by Khanna S.K., and Justo, C.E.G. Nem Chand and Brothers, Roorkee, 1998.
2. Principles and Practice of Highway Engineering by Kadiyali, L.R., Khanna Publishers, New Delhi, 1997
3. Highway Engineering by Flaherty, C.A.O., Volume 2, Edward Arnold, London, 1986.
4. Principles, Practice & Design of Highway Engineering by Sharma, S.K., S. Chand & Company Ltd., New Delhi, 1985.
5. Principles of Highway Engineering & Traffic Analysis by Mannering, Wiley Publishers, New Delhi

CIV001: Civil Engineering – Societal and Global Impact
Credits: 2
LTP 200

Course Description: The course aims to equip the students with the importance of civil engineering in shaping and impacting the world.

The course includes introduction to course and overview, Infrastructure, built environment, and civil engineering projects.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the past to look for future.

CO2: Analyze the ecological footprint of India vs other countries.

CO3: Enhance the transportation system by knowing the problems related with this.

Course Content

Unit I

Introduction to Course and Overview; Understanding the past to look into the future: Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis.

Unit II

Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering. Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground, under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water provisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure development; Innovations and methodologies for ensuring Sustainability.

Unit III

Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous waste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena and Pollution Mitigation measures, Stationarity and no stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and methodologies for ensuring Sustainability.

Unit IV

Built environment – Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound control in built environment, Security systems; Intelligent/ Smart Buildings; Aesthetics of built environment, Role of Urban Arts Commissions; Conservation, Repairs & Rehabilitation of Structures & Heritage structures; Innovations and methodologies for ensuring SustainabilityCivil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development;

Recommended Books / Suggested Readings:

1. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
2. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
3. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
4. Allen M. (2008) Cleansing the city. Ohio University Press. Athens Ohio.
5. Ashley R., Stovin V., Moore S., Hurley L., Lewis L., Saul A. (2010). London Tideway Tunnels Programme – Thames Tunnel Project Needs Report – Potential source control and SUDS applications: Land use and retrofit options
6. http://www.thamestunnelconsultation.co.uk/consultation-documents.aspx
7. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
8. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. P 129-130

BCE500: Survey camp
Credits 2
LTP 000

Course Description: The course aims to equip the students with understanding of surveying in civil engineering and how to handle tools and instruments in the field.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To impart intensive training in the use of surveying instruments
CO2: To train the students to appreciate practical difficulties in surveying on the field
CO3: Making the students conversant with the camp life
CO4: Training the students to communicate with the local population
CO5: Providing an opportunity to the students to develop team spirit
CO6: To train the students for self-management

Survey Camp of 2 weeks' duration will be held immediately after 4th semester at a Hilly Terrain. The students are required to prepare the Topographical Map of the area by traditional method. Students should also be exposed to modern Survey Equipment and practices, like Total Station, Automatic Level, GPS etc.

BCE521: Soil Mechanics Laboratory
Credits 1
LTP 002

Course Description: The course aims to equip the students with the basics of formation of soil, soil Properties, co-relation, and determine and understand soil parameters.

The course includes determination of soil properties through laboratory tests.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Carry out soil classification.

CO2: Solve three phase system problems.

CO3: Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram.

CO4: Estimate the stresses under any system of foundation loads.

CO5: Solve practical problems related to consolidation settlement and time rate of settlement.

List of experiments:

1. Determination of water content by oven drying method/rapid moisture meter.
2. Determination of specific gravity by pycnometer.
3. Determination of field density and dry unit weight by core cutter method.
4. Determination of field density by sand replacement method.
5. Determination of grain size distribution by sieve analysis.
6. Determination of grain size distribution by hydrometer analysis.
7. Determination of Atterberg's limit of soil
8. Determination of compaction properties of soil by standard proctor test.
9. Determination of shear parameters of soil by direct shear method

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BCE522: DESIGN OF CONCRETE STRUCTURES LABORATORY
Credits 1
LTP 002

Course Description: The course aims to equip the students with understanding of reinforced cement concrete, properties and design of structural elements like slab, beam, column and footing as per Indian standard codes

The course includes the properties of concrete construction material such as aggregates, cement and concrete through laboratory test.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the fundamental concepts of working stress method and limit state method.

CO2: Use IS code of practice for the design of concrete elements.

CO3: Design the beam, slab, stairs, column and footing.

CO4: Draw various R.C.C. structural elements.

CO5: Design masonry structures.

List of experiments:

1. Tests on properties of cement: Standard consistency, Initial and final setting time, Fineness, soundness and compressive strength of cement.
2. Tests on aggregates: Sieve analysis, grading, Fineness modulus, Bulk density and specific gravity of coarse and fine aggregate. Deleterious materials, Silt content and Bulking of sand.
3. Measurement of workability of concrete. Slump, compaction factor/ Vee Bee Test.
4. Concrete mix design.
5. Casting, curing and testing of concrete for compressive strength, split tensile strength, flexural strength and abrasion resistance.
6. Non-destructive testing of concrete: Ultra sonic pulse velocity test and Rebound hammer test.

Following listed RCC designs with drawings on A4 size sheet.

1. Design of slab: One way simply supported and cantilever slab
2. Design of beams, Lintels, T and L Beams.
3. Design of. Axially loaded Column with pad/sloped rectangular footing

Reference Material:

1. 'Concrete Lab Manual', M. L. Gambhir, Dhanpat Rai & Sons, New Delhi.

2. 'Concrete Lab Manual', TTTI Chandigarh.

BCE523: Transportation Engineering laboratory
Credits 1
LTP 002

Course Description: The course aims to equip the students with transportation, traffic engineering importance of Highway Drainage, Maintenance, safety and control measures.

The course includes experiments on highway materials through laboratory tests.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Carry out surveys involved in planning and highway alignment.

CO2: Design cross section elements, sight distance, horizontal and vertical alignment.

CO3: Implement traffic studies, traffic regulations and control, and intersection design.

CO4: Determine the characteristics of pavement materials.

CO5: Design flexible and rigid pavements as per IRC.

List of experiments:

1) **Tests on Sub-grade Soil**
   California Bearing Ratio Test
2) **Tests on Road Aggregates**
   a. Crushing Value Test
   b. Los Angles Abrasion Value Test
   c. Impact Value Test
   d. Shape Test (Flakiness and Elongation Index)
3) **Tests on Bituminous Materials and Mixes**
   a. Penetration Test
   b. Ductility Test
   c. Softening Point Test
   d. Flash & Fire Point Test
   e. Bitumen Extraction Test
4) **Field Tests**
   a. Roughness Measurements Test by Roughometer
   b. Benkelman Beam Pavement Deflection Test.

BCE601: DESIGN OF STEEL STRUCTURES
Credits 4
LTP 310

Course Description: The course aims to equip the students with the general design of tension, compression, beam members including connection and plastic analysis of steel structures.

The course includes Connections, Compression Member, Beams, Tension Members, Column Bases, Plastic analysis of steel structures.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the IS code of practice for the design of steel structural elements.

CO2: Design compression and tension members using simple and built-up sections.

CO3: Calculate forces on the various members of the truss and design them.

CO4: Analyze the behavior of bolted connections and design them.

CO5: Design welded connections for both axial and eccentric forces.

Course Content

UNIT I

Introduction: Types of steels and their permissible stresses. Connections: Design of riveted, bolted and welded connections under axial and eccentric loadings.

UNIT II

Compression Member: Design of compression member. Axially and eccentrically loaded compression members, built up columns, design of lacings and battens.

UNIT III

Beams: Design of beams. Simple and compound sections, main and subsidiary beams and their connections, grillage foundation. Tension Members: Design of axially and eccentrically loaded tension members. Column Bases: Design of column bases, Slab base, gusseted base

UNIT IV

Plastic analysis of steel structures: fundamentals, static and mechanism method of analysis, bending of beams of rectangular and I sections beams, shape factor, design of simply supported beams, fixed beams, continuous beams and single span rectangular frames. Roof truss: Design loads, combination of loads, design of members (including purlins) and joints, detailed working drawings.

Recommended Books / Suggested Readings:

1. Limit state design of steel structures: S K Duggal, Mc Graw Hill
2. Design of steel structures: N Subramanian Oxford Higher Education
3. Design of steel structures (Vol. 1): Ram Chandra Standard Book House – Rajsons
4. Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti I K International Publishing House
5. IS 800: 2007 (General construction in steel-Code of practice)*
6. SP: 6(1) (Handbook for structural engineers-Structural steel sections)*

*permitted in Examination

BCE602: WATER SUPPLY ENGINEERING
Credits 3
LTP 300

Course Description: The course aims to equip the students with fundamentals of Water Engineering, various components of water supply scheme, quantitative and qualitative assessment of water requirement and solve water treatment unit design problems using hydraulic principles and methods

The course includes Sources of Water and Intakes, Pumps and Pumping Stations, Quality of Water, Water Treatment System, Conveyance and Distribution and Project Economics.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Identify the source of water and water demand

CO2: Apply water distribution processes and operation and maintenance of water supply

CO3: Prepare basic process designs of water and wastewater treatment plants collect, reduce, analyze, and evaluate basic water quality data

Course Content

UNIT I

Introduction: Water supply Scheme - objectives and requirements - Domestic, commercial and public requirements - Various methods of estimating population Variations in rate of demand and its effects on design. Sources of Water and Intakes: Surface and groundwater sources - Computation of storage capacity of reservoirs by analytical and graphical methods - Forms of underground sources like wells, Infiltration wells and galleries, Intake structures, tube wells - Sanitary protection of wells.

UNIT II

Pumps and Pumping Stations: Types of pumps and their characteristics and efficiencies, Pump operating curves and selection of pumps. Pumping stations Quality of Water: Indian and W.H.O. Standards for drinking water - Impurities in water - Physical, chemical and bacteriological tests for water - quality of water for trade purpose and swimming pools

UNIT IV

Water Treatment System: Unit process of water treatment - Principles, functions and design of flocculators, sedimentation tanks, sand filters, principles of disinfection, water softening, aeration, Iron and manganese removal. Conveyance and Distribution: Service reservoir location, determination of capacity – Leak detection - lining of pipes, various materials used for pipes, selection and class of pipes - Method of Layout of distribution systems, analysis of pipe networks by different methods, pipe appurtenance for distribution system – Plumbing works and layout of water supply system for buildings, Effects of corrosion and its prevention.

UNIT VI

Project Economics: Basic principles, Tangible and intangible values, Selection of interest rate, Cash flow diagrams Discounting factors, Discounting techniques, annual cost method, benefit cost ratio method, rate of return method, Risk and uncertainty, Application to water resources problems.

Recommended Books / Suggested Readings:

1. Duggal, K.N., Elements of Environmental Engineering ,S. Chand & Company , New Delhi
2. Birdie G. S and Birdie J.S, Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi
3. Peavy, H.S., Rowe, D.R. and Tehobanoglous, G., Environmental Engineering,
4. McGraw Hill Book Company.
5. Hussain ,S.K., Water supply and sanitary engineering , Oxford & IBH, New Delhi
6. Steel, E.W., Water supply and Sewerage , McGraw Hill.
7. Fair, G.M., Gayer, I. and Okun , Water and Waste Water Engineering , John Wiley & Sons

BCE603: ADVANCED STRUCTURAL ANALYSIS
Credits 4
LTP 310

Course Description: The course aims to equip the students with analyse of beams and frames using conventional methods, apply influence line diagram for analysis of bridges, cables, girders, basics of force and displacement matrix and plastic analysis for beams, trusses and frames.

The course includes Conventional methods, Indeterminate beams, Influence line diagram, Matrix method and Plastic analysis.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Demonstrate the concepts of qualitative influence line diagram for continuous beams and frames.

CO2: Apply the methods of indeterminate truss analysis.

CO3: Demonstrate the behavior of arches and their methods of analysis.

CO4: Analyze cable suspension bridges.

CO5: Analyze multistory frames subjected to gravity loads and lateral loads.

Course Content

UNIT I

Conventional methods: Analysis of fixed beams, Continuous beams and simple frames with and without translation of joint, Method of Consistent Deformation, Slope-Deflection method, Moment Distribution method, Strain Energy method

UNIT II

Indeterminate beams: Muller-Breslau's Principle and its applications for drawing influence lines for indeterminate beams, Analysis of two hinged arches, Influence line diagrams for maximum bending moment, Shear force and thrust.

UNIT III

Influence line diagram: In Suspension Bridges, Analysis of cables with concentrated and continuous loadings, Basics of two and three hinged stiffening girders, Influence line diagrams for maximum bending moment and shear force for stiffening girders.

UNIT IV

Matrix method: Basics of Force and Displacement Matrix methods for beams and trusses. Plastic analysis: Basics of Plastic Analysis, Applications of Static and Kinematic theorem for Plastic Analysis of Beams and Frames.

Recommended Books / Suggested Readings:

1. Basic structural analysis - C.S. Reddy Tata McGraw-Hill
2. Intermediate structural analysis - C . K. Wang. McGraw Hill
3. Indeterminate structural analysis - J. Sterling Kinney Addison-Wesley Educational Publishers
4. Theory of structures - B.C. Punima, Laxmi Publications
5. Structural Analysis, Devdas Menon, Narosa Publishers

BME600: MINOR PROJECT
Credits: 1
LTP 002

Course Description: The course aims to provide the opportunity to the students so that they can apply what they have learnt in previous stages in a real-life engineering context. Application of engineering knowledge in analysis of problems and synthesis of solution while considering various constraints.

The course includes submission of project synopsis report to the concerned project guide which includes introduction, feasibility study, methodology/ planning of work, facilities required for proposed work and bibliography.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Analyse and select the project title

CO2: Know the applications of the various elements, materials used to make them, and methods used

CO3: Submit the report in the prescribed format.

Synopsis Content

Introduction (should not exceed 2 pages)
The introduction part will include the brief introduction about the project to be developed, technology used, field of project (if specialized one), any special technical terms about the project

Feasibility Study: (should not exceed 1 page)
Feasibility study of the project that include the feasibility, need and significance of the project

Methodology/ Planning of work (should not exceed 1 page)
Methodology will include the steps to be followed to achieve the objective of the project during the project development.

Facilities required for proposed work: Instruments required for the development of the project. Software/Hardware

Bibliography

Here specify the description of the study material referred for the development of the project.

SPECIFICATIONS FOR SYNOPSIS

1. The synopsis shall be computer typed (English- British, Font -Times Roman, Size-12 point) and printed on A4 size paper.
2. The Synopsis shall be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
3. In the synopsis, the title page [Refer sample sheet (inner cover)] should be given first. This should be followed by index, notations/nomenclature.
4. The diagrams should be printed on a light/white background; Tabular matter should be clearly arranged. Decimal point may be indicated by full stop (.)The caption for Figure must be given at the BOTTOM of the Fig. and Caption for the Table must be given at the TOP of the Table.

BCE621: DESIGN OF STEEL STRUCTURES LABORATORY
Credits 1
LTP 002

Course Description: The course aims to equip the students with the knowledge of general design of tension, compression, beam members including welded, riveted and bolted connections of steel structures.

The course includes designing and drawing various steel structures drawing using Indian Standard recommendations.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Design steel structural elements according to IS recommendations.

CO2: Analyze, design and draw detailed structural elements of compression and tension members using simple and built-up sections.

CO3: Analyze, draw and design various connections used in steel structures.

CO4: Design and draw welded connections for both axial and eccentric forces using different softwares.

List of experiments:

1. Structural Drawings of tension and compression members using software Auto CAD, STAAD PRO V8i and ROBOT STRUCTURAL ANALYSIS.
2. Structural Drawings of welded, riveted and bolted connections using Auto CAD, STAAD PRO V8i and ROBOT STRUCTURAL ANALYSIS.
3. Structural Drawings of steel beams and columns using Auto CAD, STAAD PRO V8i and ROBOT STRUCTURAL ANALYSIS

BCE622: WATER SUPPLY ENGINEERING LABORATORY
Credits 1
LTP 002

Course Description: The course aims to equip the students with fundamentals of Water Engineering, various components of water supply scheme, quantitative and qualitative assessment of water requirement and solve water treatment unit design problems using hydraulic principles and methods.

The course includes treatment of water through laboratory experiments.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Identify the source of water and water demand.

CO2: Apply water distribution processes and operation and maintenance of water supply.

CO3: Apply the water treatment concept and methods.

CO4: Prepare basic process designs of water and wastewater treatment plants collect, reduce, analyze, and evaluate basic water quality data.

List of experiments:

1. To measure the pH value of a water/waste water sample.
2. To determine optimum Alum dose for Coagulation.
3. To find MPN for the bacteriological examination of water.
4. To find the turbidity of a given waste water/water sample
5. To find B.O.D. of a given waste water sample.
6. To measure D.O. of a given sample of water.
7. To determine of Hardness of a given water sample
8. To determine of total solids, dissolved solids, suspended solids of a given water sample.
9. To determine the concentration of sulphates in water/wastewater sample.
10. To find chlorides in a given sample of water/waste water.
11. To find acidity/alkalinity of a given water sample
12. To determine the COD of a wastewater sample.

References:
• Chemistry for Enviromental Engg. and Science by Sawyer & McCarty, TMH, New Delhi
• Standard Methods for the examination of water & wastewater, APHA, AWWA, WE.

BCE701: ADVANCED REINFORCED CONCRETE DESIGN
Credits: 4
LTP 310

Course Description: The course aims to equip the students with understanding of the concept of designing in flat slabs, retaining walls and tanks

The course includes fundamentals of analysis of pre-stressed sections.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the concepts of liquid retaining structures

CO2: Design material storage structures using various theories

CO3: Apply the concepts of environmental and transportation structures

Course Content

Unit I

Design of Footing: Design of isolated footing, square, circular and rectangular. Design of Combined Footing: Trapezoidal and Rectangular, Design of strap and Raft Footing.

Unit II

Stresses in flat slabs: Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method).

Unit III

Designing of retaining walls: Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall.Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert.

Unit IV

Design of tanks: Design criteria, material specifications and permissible stresses for tanks, design concept of circular and rectangular tanks situated on the ground / underground, design of overhead tanks. Concept of prestressing: Advantages of prestressing, methods of prestressing, losses in prestress, analysis of simple prestressed rectangular and T-section.

Recommended Books / Suggested Readings:

1. Reinforced Concrete Design by Pillai & Menon , TMH.
2. Prestressed Concret by N Krishna Raju , New Age,
3. Limit state Design of Reinforced Concrete. Varghese P C. Prentice-Hall of India Pvt. Ltd".
4. Reinforced Cement Concrete, Mallick and Rangasamy. Oxford-IBH.

BCE700: Major project
Credit :4
LTP 008

Course Description: The course aims to equip the students with the knowledge of analysis of problems and synthesis of solution.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:
CO1: To provide the opportunity to the students so that they can apply what they have learnt in previous stages in a real-life engineering context.

CO2: To enable the student to apply engineering knowledge in analysis of problems and synthesis of solution while considering various constraints

In the Final Year (7th Semester) student have to submit their project along with report to the concern faculty.

GUIDELINES FOR STUDENTS AND FACULTY:
1. Students have to finalize their project title based on Project Synopsis submitted in 6th Semester.
2. The projects selected should be so as to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The term work will consist of a report prepared by the student on the project allotted to them.
3. Project topics may be chosen by the student or group of students with advice from the faculty members.
4. The design a project may be based on
(i) Entirely on study and analysis of a typical Instrumentation and Control System,
(ii) Experimental verification, or
(iii) Design, fabrication, testing and calibration of an Instrumentation system.
The software based project can be considered based on its application for instrumentation and control purpose. The students are required to submit the report based on project work done.
5. Use appropriate tools for the preparation of the report.
6. Each student/group is required to
a. One page synopsis before the project talk for display on the notice board in the first week of their academic semester.
b. Give a 10 minutes presentation through OHP/ PC followed by a 10 minute discussion in the second week of their academic semester.
c. Submit a report on the project topic with a list of required hardware, software or other equipment for executing the project in the third week of their academic semester.
d. Start working on the project and submit initial development and CPM/PERT planning drawing in the fourth week of their academic semester.
e. Preparation of PCB layout, wiring diagram, purchase of components, software demo, flowchart, algorithm, program/code, assembling, testing, etc. should be submitted by student/s within next five/Six weeks and minimum one page report should be there for each major activity.
f. Overall assembling, wiring, code writing, testing, commissioning, should completed within next two weeks.
g. At the last but one week of end of academic semester the internal assessment of project will be done by panel of internal faculties. In the last week, student/group will submit final project report to guide
7. Projects are to be scheduled in the weekly scheduled time-table during the semester and any change in schedule should be discouraged.

8. Every assigned faculty/s should maintain separate file for evaluating progress of each student or group.
9. The format and other guidelines for the purpose of the Project Submission in hard bound copies should be as follows,

REPORT STRUCTURE

Index/Contents/Intent List of Abbreviations List of Figures List of Graphs List of Tables and List of if any other inclusion

1. INTRODUCTION
1.1 Introduction
1.2 Necessity
1.3 Objectives
1.4 Theme
1.5 Organization

2. LITERATURE SURVEY Literature Survey Related information available in standard Books, Journals, Transactions, Internet Websites *etc.* till date (More emphasis on last three to five years)

3. SYSTEM DEVELOPMENT

Model Development • Analytical • Computational • Experimental • Mathematical • Statistical (out of above methods at least one method is to be used for the model development)

4. PERFORMANCE ANALYSIS

● Analysis of system developed either by at least two methods depending upon depth of standard • These methods normally used are Analytical /Computational/ Statistical/ Experimental/ or Mathematical • Results at various stages may be compared with various inputs • Output at various stages with same waveforms or signals or related information /parameters • Comparison of above results by at least two methods and justification for the differences or error in with theory or earlier published results

5. CONCLUSIONS

5.1 Conclusions
5.2 Future Scope
5.3 Applications Contributions (if any,) the innovative work/invention/new ideas generated from the analysis of the work which can be taken from the conclusions.

REFERENCES ● Author, "Title", Name of Journal/Transactions/ Book, Edition/Volume, Publisher, Year of Publication, page to page (pp.__). These references must be reflected in text at appropriate places in square bracket in case of web pages' complete web page address with assessing date has to be enlisted List of references should be as per use in the text of the report.
APPENDICES Related data or specifications or referred charts, details computer code/program, *etc*. (1 Page) Expression of gratitude and thankfulness for helping in completion of the said task with name Signed by the candidate

● **General Guidelines** Text should be printed on front and correct side of the watermark on quality bond paper Paper size- A4, 75 to 85 gsm paper Left Margin-1.5" Right Margin-3/4" Top Margin-1" Bottom Margin-1" • First page of first chapter need not be printed anywhere, second page onwards at right hand corner at ½ inch from right and top side from second chapter onwards starting page number of chapter should be printed at bottom center place report total pages –around. All Greek words must be italic Report Heading -All Capital—16 Font Chapter heading -All Capital—14 Font Subchapter –title case-12 Font Sub-Subchapter –First Alphabet Capital case-12 Font Page numbers for Index/Contents/Intent should be in roman Title of the Report should not be more than two lines Text pages should be in times new roman.
For more information and sample of hard copy please contact the respective Head of the Department.

BCE721: COMPUTER AIDED STRUCTURAL DESIGN AND ANALYSIS LABORATORY
Credits: 3
LTP 006

Course Description: The course aims to equip the students with knowledge of plotting and designing both the reinforced and steel structure.

The course includes reinforcement, structural elements, steel profile, project modification, tools and tables.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Plot the structural elements drawing with detailing.

CO2: plot the steel elements using steel profile.

CO3: design the elements using IS code in the soft tool.

Course Content

Unit I

Reinforcement: unit system, codes/material, reinforcement elevation, reinforcement cross sections, special stirrups, reinforcing bars symbols, reinforcement distribution, surface/radial reinforcement bars, wire fabrics, bar descriptions, bar end symbols, distribution descriptions

Unit II

Structural elements: footing, beam, columns, slab, spread footings, sleeve footings, continuous footing, slab corners, retaining walls, stairs, ground beams, parapet, create linear elements, insert linear elements, pile, pile cap, distribution of prefabricated slabs, additional connecting elements, use 3D solids, graphics elements styles

Unit III

Steel profile: Steel profile definition, profile types, materials, insertion axis, offsets, rotations, steel profile description, steel profile sections, cut profile to line, delete cut. Project modifications: modification of reinforcement, reinforcement descriptions, lap splices, multi reinforcements, bend diameters, assign shape codes, covers, set scale of reinforcement description, graphics parameter, edit bar/fabrics database

Unit IV

Tools & Table Create sections, copy views, create views, renumbering of reinforcing positions, save format in dwg format, explode, insert drawing from robot, insert axis, insert elevation marks on plane Table: Bar bending schedule, Reinforcement detail table, reinforcement elements table, bars detail table, bars summary table, Wire fabrics main tables, wire fabrics summary tables, table printout, import/export.

Recommended Books / Suggested Readings:

1. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K International Publishing House Pvt. Ltd., New Delhi, 3rdrevised edition- 2006.
2. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.
3. D.M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi.
4. Jolhe, Dhananjay (2006), Engineering Drawing: With an Introduction to CAD, Tata Mc Graw Hill, India.

BCE801: ENERGY SCIENCE AND ENGINEERING
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the fundamentals of energy and environment, and energy efficient design strategies in designing of buildings.

The course includes introduction, environmental, services, and energy management.

Course Outcomes (CO):
Upon successful completion of the course, the students should be able to:

CO1: identify the consumption of energy both in domestic and residential.

CO2: Design green buildings.

CO3: Use energy efficient design strategies.

Course Content

Unit I

Introduction: Fundamentals of energy - Energy Production Systems - Heating, Ventilating and air conditioning -Solar Energy and Conservation - Energy Economic Analysis - Energy conservation and audits -Domestic energy consumption - savings -Energy use in buildings - Residential - commercial buildings. Green building concepts

Unit II

Environmental: Energy and Resource conservation - Design of green buildings - Evaluation tools for building energy - Embodied and operating energy - Peak demand - Comfort and Indoor air quality - Visual and acoustical quality - Land, water and materials - Airborne emissions and waste management. Design: Natural building design consideration - Energy efficient design strategies - Contextual factors - Longevity and process Assessment -Renewable energy sources and design- Advanced building Technologies - Smart buildings - Economies and cost analysis.

Unit III

Services: Energy in building design - Energy efficient and environment friendly building - Thermal phenomena - thermal comfort - Indoor Air quality - Climate, sun and Solar radiations - Psychometrics - passive heating and cooling systems - Energy Analysis - Active HVAC systems - Preliminary Investigation - Goals and policies - Energy audit - Types of energy audit - Analysis of results - Energy flow

Unit IV

Energy Management: Energy management of electrical equipment - Improvement of power factor - management of maximum demand - Energy savings in pumps - Fans - Compressed air systems - Energy savings in Lighting systems – Air conditioning systems - Applications.

Recommended Books / Suggested Readings:

1. Contract Management & Dispute Resolutions , S. Ranaga Rao, Engineering staff College of India
2. Building Science and Design by M.S.Sodha, N.K. Banaal, P.K.Bansal, A.Rumaar and M.A.S. Malik, Solar Passive: Pergamon Preen (1986).
3. Thermal Environment Engineering by Jamee. L. Threlked, Prentice Hall, INC-, Raglevood Cliffs, New Jersey (1970).
4. Building, Climate and Energy by T.A. Markus and R.N. Morris, Spottwoode Ballantype Ltd-, London U.K. (1980).
5. Solar Thermal Energy Storage, H. P. Garg et.al, D. Reidel Publishing Company (1985).
6. Mathematical Modeling of Melting and Freezing Process, V Alexiades & A.D. Solomon, Hemisphere Publishing Corporation, Washington (1993).
7. Energy storage technologies, a reading material prepared by Dr. D. Buddhi, School Of Energy And Environmental Studies, DAVV, Indore.

BCE800: INDUSTRIAL DEFINED PROJECT
Credits: 8
LTP 0016

Course Description: The course aims to equip the students with engineering knowledge in analysis of problems and synthesis of solution while considering various constraints

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To provide the opportunity to the students so that they can apply what they have learnt in previous stages in a real-life engineering context
CO2: To enable the student to apply engineering knowledge in analysis of problems and synthesis of solution while considering various constraints

Industrial Defined Project is a project performed by individual student or group for their last year project from industry. This is to be engaged during last semesters at industry where you are engaged for the project. The solutions to the problems and obstacles are solved by the external and internal guide.

GUIDELINES FOR STUDENTS AND FACULTY:

1. The final semester industrial defined project should be based upon a real-life problem of an industry.
2. If a faculty member, using his experience, gives a problem to a student for his/her final year project, the student can use the problem to write the IDP. However, the IDP proposal will have to be submitted in the required format.
3. The students will scout for the Industrial Defined Project (IDP) before commencement of the first semester of the final academic year. Within two weeks of commencement of academic session, the student will take review inputs from the faculty member, who is to be his Guide for the project. He will then submit a report on the problem to the HOD.
4. The final year project will be designed to develop a better product or a better process.
5. The number of students per group for a project has to be decided by the University.
6. Any student can go to any industry.
7. The students can take inter-disciplinary projects during the final year after consultation with the corresponding Guide in respective colleges.
8. The students have to mention the name of the industry / source of the industry defined project while submitting the project definition immediately after commencement of the academic session. (In some cases, the industry may jointly mentor and evaluate the progress of the project during the academic semester).
9. Those students who have already undergone the training or industrial visit can define a project definition from the respective industries, based on the training or industrial visit.
   The students will have to submit the problem / project definition to the concerned college in soft copy. The problem definition should have content as per the given guidelines including details of previous attempt to solve such problems / projects and the proposed ways to solve the problem / process by the concerned student or the team of students in particular college while developing it in his/her final semester.

REPORT STRUCTURE: For report structure student may refer structure as per Course: PROJECT:1

B.Tech Civil Engineering
PEC - Professional Elective Course

BCE541: Hydrology and water resources engineering
Credits 3
LTP 300

Course Description: The course aims to equip the students with the importance of Water Resources, the various components of the water cycle and their importance and data analysis using various techniques and implementation of the results.

The course includes, Precipitation, Abstractions from Precipitation, Runoff, Peak Flows and Reservoir Planning.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Demonstrate the concepts of hydrograph, S-hydrograph, Unit hydrograph and IUH

CO2: Estimate the hydrological parameters

CO3: Carry out statistical and probability analysis of hydrological data

CO4: Demonstrate the concepts of hydrological systems

CO5: Develop regression models for the analysis of hydrological data.

Course Content

UNIT I

Introduction: Importance of hydrological data in water resources planning. The hydrologic cycle. Mechanics of precipitation, types and causes, measurement by rain gauges, Gauge net-works, hyetograph, averaging depth of precipitation over the basin, mass-rainfall Curves

UNIT II

Precipitation: Types Forms, Measurement by rain gauge and other methods, Design of rain gauges station, mean precipitation, Presentation of rainfall data, Estimation of messing rainfall data. Test for consistency of record, Analysis of rainfall data, Intensity depth area relationship, Duration Frequency curves, Depth Area Duration curves, Frequency analysis of rainfall data

UNIT III

Abstractions from Precipitation: Evaporation, Factors affecting evaporation, Measurement by different methods, Evaporation measurement, infiltration, Factors affecting infiltration Measurement, Infiltration capacity curve, Infiltration indices. Runoff: Factors affecting runoff, Base flow separations, run-off hydrograph, unit hydrograph theory, S-curve hydrograph, Synder's synthetic unit hydrograph.

UNIT IV

Peak Flows: Estimation of Peak flow-rational formula, use of unit hydrograph, frequency analysis, Gumbel's method, design flood and its hydrograph. Reservoir Planning: Types of reservoir, Storage zones, Selection of reservoir site, Mass curve analysis for reservoir capacity, Reservoir yield and its determination for a given reservoir capacity, Reservoir sedimentation and its control, Reservoir evaporation and Methods for its reduction

Recommended Books / Suggested Readings:

1) Engineering Hydrology - J.Nemec, Prentice Hall
2) Engineering Hydrology by Stanley Buttler, John. Wiley
3) Applied Hydrology, V.T. Chow, D.R. Maidment, and L.W. Mays, McGraw Hill.
4) Elementary Hydrology, V.P. Singh, Prentice Hall.
5) Hydrology – Principles, Analysis and Design, H.M. Raghunath, Wiley Eastern Ltd.
6) Groundwater Hydrology, D.K. Todd ,John

BCE542: ROCK MECHANICS AND ENGINEERING GEOLOGY
Credits 3
LTP 300

Course Description: The course aims to equip the students with engineering geology, rock mechanics and basic information about earthquake

The course includes General Geology, Rocks & Minerals, Structural Geology and Earthquake

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Identify the problem associated with underground excavations

CO2: Understand the failure criteria of rock

CO3: Determine in- situ stresses from field test data

Course Content

UNIT I

General Geology: Importance of Engineering Geology applied to Civil Engg. Practices. Weathering, definition, types and effect. Geological works of rivers, wind, glaciers as agents of erosion, transportation and deposition. Rocks & Minerals: Minerals, their identification, igneous, sedimentary & metamorphic rocks. Classification of rocks for engineering purposes. Rock quality designation (RQD

UNIT III

Structural Geology: Brief idea about stratification, apparent dip, true dip, strike and inconformities. Folds, faults & joints: definition, classification relation to engineering operations. Engineering Geology: Geological considerations in the Engg. Projects like tunnels, highways, foundation, dams, reservoirs

UNIT IV

Earthquake: Definition, terminology, earthquake waves, intensity, recording of earthquake. Engineering properties of rocks and laboratory measurement: Uniaxial compression test, tensile tests, permeability test, shear tests, size and shape of specimen rate of testing. Confining pressure, stress strain curves of typical rocks. Strength of intact and fissured rocks, effect of anisotropy, effect of saturation and temperature.

UNIT IV

In-situ determination of Engg. Properties of Rock masses: Necessity of in-situ tests, uniaxial load tests in tunnels and open excavations, cable tests, flat jack test, shear test, pressure tunnel test. Simple methods of determining in situ stresses, bore hole test, Improvement in properties of Rock masses: Pressure grouting for dams and tunnels, rock reinforcement rock bolting.

Recommended Books / Suggested Readings:

1. Introduction to Rock Mechanics: Richard E. Goodman.
2. Engg. Behaviour of rocks : Farmar, I.W.
3. Rock Mechanics and Engg. : Jaager C.
4. Fundamentals of Rock Mechanics : Jaager and Cook
5. Engineering Geology : D.S.Arora
6. Engineering Geology : Parbin Singh
7. Rock Mechanics for Engineering : B.P. Verma.

BCE543: ADVANCED CONSTRUCTION TECHNIQUES

Credits 3

LTP 300

Course Description: The course aims to equip the students with the understanding of advanced construction techniques in substructure super structure and repair construction

The course includes advanced construction techniques for sub structures and super structures

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply substructure construction techniques like box jacking and sheet piling

CO2: Understand and analyze superstructure construction elements like slip form techniques, launching techniques erection procedures etc. associated with tall, large span and offshore structures

CO3: Understand the need and application of advancements in construction techniques and methods in concreting

Course Content

UNIT I

Sub structure construction: Box Jacking -pipe jacking, diaphragm walls types and methods, piling Techniques, driving well and caisson, sheet piles, construction procedures and applications, cofferdam methods -cable anchoring and grouting, laying operations for built up offshore system, shoring for deep cutting, well points, dewatering and stand by plant equipment for underground open excavation trenchless technology.

UNIT II

Tall structures construction: Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections launching techniques, Slip form techniques suspended
form work, erection techniques of tall structures, large span structures, launching techniques for heavy decks, in situ prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures

UNIT III

Large span structures construction: Types of bridges and loading standards Bow string bridges, cable stayed bridges. Construction aspects and inspection and maintenance of bridges. Launching and
pushing of box decks. Construction sequence and methods in domes and prestressed domes, various construction techniques of domes –methods-merits and demerits and space decks support structure for heavy equipment and conveyor and machinery in heavy industries.

UNIT IV

Special structure construction: Erection of lattice towers and rigging of transmission line structures, construction procedures of cooling towers, silos, chimney, sky scrapers. Advanced construction techniques in offshore construction practice, Vacuum dewatering of concrete flooring, white topping, methods and application, erection of articulated structures, floating structures-methods. Mud Jacking grout through slab foundation, micro piling for strengthening floor and shallow profile pipeline laying, protecting sheet plies, screw anchors, sub grade water proofing -under pinning, crack stabilizing techniques, advanced techniques. Explosives and its classification. Sequence in demolition and dismantling.

Recommended Books / Suggested Readings:

1. Roy Chudley, Roger Geeno," Advanced Construction Technology" Latest Edition, 2005.

2. Ponnuswamy .S,"Bridge Engineering "Second Edition, 2008.

BCE544: CONSTRUCTION PLANNING AND ORIENTATION
Credits 3
LTP 300

Course Description: The course aims to equip the students with the understanding of the fundamental concepts of planning and orientation of Residential buildings, Miscellaneous building, Tall buildings and smart buildings

The course includes a detailed planning of residential and miscellaneous buildings.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To decide the orientation basics for residential buildings, miscellaneous building

CO2: Understand the orientation basics for Tall buildings and smart buildings

Course Content

UNIT I

Planning for residential buildings (part 1): Introduction to building planning, Vastu shastra and architecture, Room planning, living area, drawing room, Dining room, Office room, Guest room, Recreation room, Entrance Foyer, Bed room, bathroom and water closets, Service area, Kitchen, Storage Garage, hostels, hotels motels, Guest house.

UNIT III

Planning for miscellaneous buildings (part 2): Office buildings, Merchandise buildings, stores, shopping centres, shopping markets, Industrial buildings, buildings for record storage, museum and art galleries, railway stations, bus stations, television stations, radio stations, Municipal buildings.

UNIT IV

Multi-storied and tall buildings: Multi storied buildings, setting and orientation of multi storied buildings, work stations, tall buildings, structural system in tall buildings, fire safety, planning of tall structures, techniques involved in the construction of tall buildings, Earthquake resistance in tall buildings, intelligent tall buildings.

UNIT IV

Eco friendly buildings: Environment man relationship, environmental stress, environmental protection, greenhouse effect, eco-friendly buildings, sustainable buildings, green buildings, features of green buildings, green building materials, design of green buildings, rating system, solar passive architecture and building planning, rain water harvesting.

Recommended Books / Suggested Readings:

1. Deodhar .S.V, "Building Science and Planning", Anna publishers, 2011.

BCE641: GEOMATICS ENGINEERING
Credits 3
LTP 300

Course Description: The course aims to equip the students with skills of analyzing the method of Tachometry, Traingulation and Curve in surveying while applying geo-informatics approach.

The course includes fundamentals of aerial photographs, remote sensing, satellite image and global positioning system (GPS)

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Scale the images according to their use.
CO2: Plot the map by using the aerial photograph.
CO3: Use the application for collecting data.

Course Content

UNIT I

Tachometry and Curves: Definition, determination of tachometer constants and reduced level from tachometric observations. Triangulation: Selection of stations and base line, corrections for base line, satellite station and reduction to centre. Curves: Elements of a simple curve, different methods of setting out of simple circular curve.

UNIT II

Aerial Photographs: Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation, Introduction to Digital Photogrammetry. Remote Sensing: Physics of remote sensing, Remote sensing satellites and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

UNIT III

Satellite Image: Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing Geographical Information System (GIS): Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications.

UNIT IV

Global Positioning System (GPS): Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Datum, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications

Recommended Books / Suggested Readings:

1. Surveying Vol I & II, by Duggal, S.K., Tata McGraw Hill (2006)
2. Surveying Vol. I and II by Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Laxmi Publications (2005)
3. Surveying Vol-III by Arora, K.R., 2007:Standard Book House.
4. Introduction to Remote Sensing by Campbell, J.B.2002: Taylor Publications.
5. Geographic Information Systems by Chang.T.K. 2002:,Tata McGrawHill.
6. An Introduction to Geographical Information Systems, by Heywood.I, Cornelius S, CrverSteve. 2003: Pearson Education.
7. Fundamentals of Remote Sensing by Joseph George, 2003: Universities Press.
8. Higher Surveying by Punmia, B.C., Jain A.K., 2005:, Luxmi Publications
9. Remote Sensing Principles and Interpretation by Sabbins, F.F., 1985: W.H.Freeman and company.

BCE642: GPS Surveying.
Credits : 3
LTP 300

Course Description: The course aims to equip the students with the fundamental and advance concept and applicatins of Global Positing System (GPS) to the undergraduate students of civil engineering.

The course includes Introduction to Godesy, Fundamental of GPS, GPS Code, GPS field survey technique. .

Course Outcomes (CLO):

Upon successful completion of the course, the students should be able to:

CO1: To understand the Earth's Geodetic and Reference system.

CO2: To understand the concepts and components of GPS.

CO3: To study the basic principles of GPS, its merits and demerits

CO4: To understand the various errors and biases in GPS.

CO5: To study the various application of GPS.

Course Content

Unit I

INTRODUCTION TO GEODESY: Definitions and fundamentals of Geodesy, Earth Geoid and Ellipsoid of rotation, Reference surface, Geodetic systems, Indian Geodetic System, Coordinate systems.

Unit II

Fundamentals of global positioning system: History: NAVSTAR GPS, GLONASS, Indian Regional navigational Satellite System (IRNSS) - Design objectives - Details of segments space, control and user - Advantages and current limitation.

Unit III

GPS codes: C/A, P - GPS receiver: Structure of receivers and Types – Receiver selection - Principles of position fixing: Pseudo ranging - Types of ephemerides and Data formats. Satellite dependent: Ephemeris errors - Satellite clock bias – Selective availability. Receiver dependent: Receiver clock bias - Cycle slip – Selective availability (SA).Observation medium dependent: Ionospheric errors – Tropospheric errors.Station dependent: Multipath - Station coordinates.Satellite geometry based measures: Geometry dependent (Dilution of Precision: DOP)

Unit IV

GPS Field Survey techniques: static surveying and kinematics surveying – DGPS Survey - Preparation of GPS surveys: Setting up an observation plan – Observation strategies - Network design. GPS Applications: Cadastral surveys – Remote Sensing and GIS - Military applications and Vehicle Tracking.

Recommended Books / Suggested Readings:

1. Akash Deep Sharma, "Global Positioning System", MD Publication Pvt. Ltd, New Delhi (India), 2008.
2. Hofmann Wellenhof, B., Lichtenegger, H. and Collins, J., "Global Positioning System: Theory and Practice", Springer, Berlin (Germany), 1994.
3. Bradford W. Parkinson, James J. Spiker Jr., "Global Positioning System: Theory and Applications", Vol I and II, American Institute of Aeronautics and Astronautics: Washington (USA), 1996.
4. Gunter Seeber, "Satellite Geodesy", Walter de Gruyter, Berlin (Germany), 2003.
5. Anji Reddy .M, "Textbook of Remote Sensing and Geographical Information System", BS Publications, Hydrabad (India), 2012.
6. SatheeshGopi, "Global Positioning System - Principles and Applications," Tata McGraw-Hill Publishing Company Limited, New Delhi (India), 2005.

BCE643: CONCRETE COMPOSITE MATERIAL

Credits 3

LTP 300

Course Description: The course aims to equip the students with properties of various composite materials and awareness recent development in concrete

The course includes Fibre reinforced concrete, Fly ash concrete, Polymer concrete, Ferro cement, High performance concrete and Lightweight concrete

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the concepts of composite construction in engineering.

CO2: Understand the major difference between various concretes.

CO3: Prepare the different concrete according to their utilization.

CO4: Use the constituent material with concrete

CO5: Utilize the fly ash in cement concrete.

Course Content

UNIT I

Fibre reinforced concrete: Properties of Constituent Materials, Mix Proportions, Mixing and Casting Procedures, Properties of Freshly mixed FRC, Mechanics and properties of Fibre reinforced concrete, Composite Material approach, Application of fibre reinforced concrete. Fly ash concrete: Classification of Indian Fly ashes, Properties of Fly ash, Reaction mechanism, Proportioning of fly ash concretes, Properties of Fly ash concrete in fresh and hardened state, Durability of fly ash concrete.

UNIT II

Polymer concrete: Terminology used in polymer concrete, Properties of constituent materials, Polymer impregnated concrete, Polymer modified concrete, Properties and applications of polymer concrete and polymer impregnated concrete Ferro cement**:** Constituent materials and their properties, Mechanical properties of ferro cement, Construction techniques and application of ferro cement

UNIT III

High performance concrete: Materials for high performance concrete, Supplementary cementing materials, Properties and durability of high-performance concrete, Introduction to silica fume concrete, Properties and applications of silica fume concrete.

UNIT IV

Lightweight concrete: Properties of lightweight concretes, Pumice concrete, Aerated cement mortars, No fines concrete, Design and applications of lightweight concrete. Recent developments in construction materials for Cladding, Waterproofing, Tiles, paints, Formwork, Decorative interiors etc

Recommended Books / Suggested Readings:

1. Gambhir M L, "Concrete Technology" Tata McGraw Hill, New Delhi, 1995.Concrete Technology-M.L. Gambhir
2. Neville A M and Brookes J J, "Concrete Technology" Pearson Publishers, New Delhi,1994.

BCE644: SMART CITY AND URBAN PLANNING
Credits 3
LTP 300

Course Description: The course aims to equip the students with Smart city and urban planning, knowledge about the need of town planning and urban development and the trend of urbanization and planning process

The course includes Town planning, Road and street systems and Legislation and Urban Controls.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the principal of smart city and urban planning
CO2: Manage the land for urban planning.
CO3: Solve the problem for minimizing the construction cost and maximum benefits.

Course Content

UNIT I

Introduction: Smart city, smart city features, present scenario of Indian cities. Town planning: Objective of town planning, Planning process Principal elements and the location of public functions with reference to Roman, Greek, Medieval, Renaissance and industrial towns, Urbanization and settlement structure.

UNIT II

Growth of the Industrial Town: Need & Purpose, Characteristics of the Factory Town, Trends in Modern Town Planning- Linear city- Soria Y Mata, Garden city- Ebenezev Howard, Broad acre city- Le Corbusier. Planning Process: Site Selection, Land uses in a town, their hierarchy and location, Types of town shapes with reference to circulation (Linear, Star, grid, Satellite). Sustainable development: Advantages and usage of sustainable materials and sustainable technologies, Green building concept, rating systems

UNIT III

Road and street systems: Road and town aesthetics. Urban land uses & management: Zoning Need and purpose in a master plan. Density-net and gross, bulk & height. FAR, FSI, Neighborhood- The neighborhood concept by Clarence Stein. Functions of a neighborhood, population size and layout, with respect to the Chandigarh sector. Distributions of facilities within a neighborhood (shopping, health, education and recreation). Circulation System- Hierarchy of road network in a town. Modes of transport and modal split in a town. Familiarization with terms: Traffic flow, peak hour volume, traffic distribution. Commercial Areas: Hierarchy of Commercial Area in a Town/City and their foundation, Open Spaces: Their location, distribution and hierarchy within a town.

UNIT IV

Legislation and Urban Controls: Need and purpose of development controls in towns, Obligatory and discretionary functions of Urban Local Bodies and Development Authorities. Slum clearance, urban renewal, conservation, rehabilitation and redevelopment. Decentralization policies. Review of various urban development schemes and projects.

Recommended Books / Suggested Readings:

1. Urban Design of Towns & Cities – Paul D. Spreiregen
2. Urban Pattern- Cyallion B Fischer
3. Town Planning made Plain-Lewis Keeble
4. From Pre History to Post Modernism-Isabelle Hyman
5. Town Planning by S. Rangwala
6. Text Book of Town Planning-Abir Bandyo Padhyay
7. Indian Cities in Arid West By Jain, Kulbhushan
8. City Shaped: The elements of Urban Form through history, Little Brown, 1992 Boston. Kostoff, Spiro

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BCE645: FOUNDATION ENGINEERING
Credits 3
LTP 300

Course Description: The course aims to equip the students with design & analysis of shallow foundations, basics of foundation on difficult soil and fundamentals of pile foundation and raft foundation
The course includes Soil Investigation, Shallow foundation , Shallow foundation , Pile foundations and Foundation on difficult Soils

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Analyze and design any kind of sheet pile wall system including coffer dam

CO2: Analyze and design well foundation including complete stability analysis

CO3: Estimate soil parameters under dynamic conditions including machine foundations

CO4: Design a suitable foundation system for any kind of problematic soils

CO5: Analyze the stability of any kind of slope by using both theoretical and graphical methods

Course Content

UNIT I

Soil Investigation: Object of 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 the following types of samples - Open Drive samples, Stationery piston sampler, Rotary sampler. Geophysical exploration by seismic and resistivity methods. Bore Hole log for S.P.T.**:**

UNIT II

Shallow foundation - I: Methods of estimation of bearing capacity computation of bearing capacity factors, Effect of eccentric and inclined loads effect of water table on bearing capacity, Moyerhof's analysis, Bearing capacity of stratified soils, Methods of estimation of settlement of footings.

UNIT III

Shallow foundation - II: Indian Standard Code Provisions (IS: 1904, 6403, 8009). Determination of allowable bearing capacity as per IS code. Schemartman's method, Dee beer's and Mortin method of finding out settlement from static cone penetration test. Methods of finding out bearing capacity from plate load test, standard penetration test data. Well foundations: design and construction. Bearing capacity, settlement and lateral resistance. Tilts and shifts, IS and IRC codes methods. Raft foundation: common types of raft, combined footing. Bearing capacity of raft, differential settlement of raft. semi empirical method of design of raft foundation..

UNIT IV

Pile foundations: types of pile and their use, modes of failure. Bearing capacity and settlement of pile foundation. Types of piles, Allowable load, Pile load test, Dynamic and static formulae. Bearing Capacity factors. Pile group bearing capacity and settlement. Negative skin friction. Behavior of piles under lateral loading. Winkler's assumption. Pile resistance and deflection under lateral loads, elastic method, Brooms method.

UNIT V

Foundation on difficult Soils: Collapsible soil. identification, Collapse settlement, foundation design. Sanitary land fills settlement of sanitary land fill. Expensive soils: Behaviour of expansive soil, foundation practices, under-reamed piles. Methods of finding out load carrying capacity of under reamed piles in clayey and sandy soil. Provision of IS 2911 Part III-1980 for design of under-reamed pile foundations.

Recommended Books / Suggested Readings:

1) Soil Mech. & Foundation Engg, by K.R.Arora, Standard Publishers Distributors.
2) Geotechnical Engineering, by P. Purshotama Raj.
3) Soil Mech. & Foundation Engg., by V.N.S.Murthy.
4) Principle of Foundation Engineering by B.M.Das, CL Engineering.
5) Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International.
6) Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons.
7) Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education.
8) Foundation Engineering by Varghese P.C, PHI Learning.

BCE646: Material, Testing and Evaluation.
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the knowledge of selecting materials for the industrial products by finding desirable properties as per IS Recommendations.

The course includes Materials properties and their behavior.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Appraisal about the role of materials in civil engineering

CO2: Introduce common measurement instruments, equipment's and devices to capture the material response under loading

CO3: Exposure to a variety of established material testing procedures/techniques and the relevant codes of practice

CO4: Ability to write a technical laboratory report.

CO5: Draw inferences drawn from observations/reports for selection of suitable material

CO6: Use and draw relevant information from the standards and guidelines

Course Content

Unit I

Material - Definition, classifications (engineering/non-engineering and structural/non-structural), types (brittle, ductile, composites and cementitious materials, etc.) and its role in engineering design & construction; desirable properties and specifications; Material microstructure (e.g. of concrete, etc) and its effect on their engineering properties.

Unit II

Strength-deformation and fracture behavior of materials; Characteristics strength of materials, determination & its reporting; Material behavior under different stress conditions; Parameters affecting the material strength; Different equipment's, devices, and instruments to characterize the material response/ behavior; Current testing technology (displacement-controlled and load controlled) and its selection for capturing the response of the material.

Unit III

Force and strain measurements, Important instrument considerations - Fatigue, impact, toughness, crushing, abrasion, permeability and other time-dependent properties, such as shrinkage, creep; Durability considerations. Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results; Use of test data/ testing reports in the material selection for
various civil engineering projects /construction.

Unit IV

Quality control - Sampling, Acceptance criterion, Code of practice and guidelines in this regards for Cements; Aggregates; Admixtures; Concrete (plain, reinforced and steel fibre/ glass fibrereinforced, light-weight concrete, High Performance Concrete, permeable Concrete); Soils; Bitumen and asphaltic materials; Timbers; Glass and Plastics; Structural Steel; Aluminum; Geotextiles; Carbon composites.

Recommended Books / Suggested Readings:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. ButterworthHeinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand & Bros, Various related updated & recent standards of BIS, IRC, ASTM, RILEM, ACI, AASHTO, etc. corresponding to materials used for Civil Engineering applications
3. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
4. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
5. Mehta, P K and Monteiro P J M (1997), Concrete: Microstructure, Properties and Materials, Tata McGraw Hill.

MCE647: FORENSIC CIVIL ENGINEERING
Credits: 3
LTP 300

Course Description: The course aims to equip the students with various aspects of investigation involved in Failure of structures.

The course includes various method of testing of failed structure, structure failure, and Geo-Technical failure.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To impart knowledge of various testing methods of Failed Structures.

CO2: To learn about aspects of failures connected with various structural systems and materials

CO3: To impart knowledge about foundation failures.

CO4: To know about strategic measures against failures.

CO5: To gain insight into previous structural failures.

Course Content

Unit I

Various methods of testing of failed structures - Laser scanning, microscope, Radio graphic evaluation, Load Testing of shoring systems and repair technology.

Unit II

Structural failures: Failure of construction materials steel, concrete - Joints by Bolt and weld. Failure of compression members and tension members by reversal of loads – Failure aspects of post tensioned concrete systems, space frame, plane frame, precast buildings, failure of bridges.

Unit III

Geo technical failures**:** Soil liquefaction, failure of foundation systems – Causes and prevention. Designing against failure: Quality control – Material selection, workmanship, design and detailing.

Unit IV

Case studies and professional practice: Case Studies on famous failures – Reasons and lessons learnt – Aspects of professional practice.

Recommended Books / Suggested Readings:

1. *Forensic Engineering – 2012*", proceedings of sixth ASCE Conference of Forensic Engineering held in San Francisco, California, Oct 31- Nov 03, 2013.

BCE648: INDUSTRIAL WASTE MANAGEMENT

Credits: 3

LTP 300

Course Description: The course aims to equip the students with the students knowledgeable in various pollution prevention methods employed in industries.

The course includes Industrialization and waste water treatment sources.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: To provide an introduction to industrial pollution prevention measures

CO2: To familiarize the methods of pollution prevention in industries, life cycle assessment of products and design for environment.

CO3: To know about the hazardous waste and disposal.

Course Content

Unit I

INDUSTRIALIZATION Industrial activity and environment-industrialization and sustainable development indicators of sustainability-sustainability Strategies-Barriers to sustainability-Pollution prevention in achieving Sustainability-Prevention Vs control of industrial Pollution-Environment policies and Regulations to encourage pollution prevention- Types of industries and industrial pollution - Characteristics of industrial wastes - Population equivalent

Unit II

Waste water treatment sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Dairy, Sugar, distilleries, Refineries, thermal power plants, Chemical Industry, Electroplating Industry - Wastewater reclamation concepts.

Unit III

Regulatory boards: Environment friendly chemical Processes-Properties of environmental contaminants - Regulations for clean environment and implications for industries- International Environmental Standards-Environmental technology assessment

Unit IV

Source reduction techniques: Waste management Approach - Waste Audit - Volume and strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery - Applications-residuals Management-Economic recovery and recycling of wastes. Hazardous wastes - Physico chemical treatment - solidification - incineration - Secured Landfills-Industrial applications of pollution prevention, Life cycle assessment, and technology assessments.

Recommended Books / Suggested Readings:

1. James G. Mann and Y.A.Liu, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 2009.
2. Eckenfelder .W.W, "Industrial Water Pollution Control", McGraw-Hill, 2009.
3. Freeman H.M., "Industrial Pollution Prevention Hand Book", McGraw Hill, 2005.
4. Arceivala ,S.J., "Wastewater Treatment for Pollution Control", Tata McGraw- Hill, 2008.
5. Frank Woodard., "Industrial waste treatment Handbook", Butterworth Heinemann, New Delhi, 2010.
6. World Bank Group "Pollution Prevention and Abatement Handbook – Towards Cleaner Production", World Bank and UNEP, Washington D.C.2008.
7. Paul L. Bishop "Pollution Prevention: - Fundamentals and Practice", McGraw-Hill International, 2010.

BCE741: ADVANCED STEEL STRUCTURE DESIGN

Credits: 3

LTP 300

Course Description: The course aims to equip the students with understanding of designing concepts of girder and roof trusses, bridges, tanks. To introduce the students to the general design of tension, compression, beam members including connection.

To introduce plastic analysis of steel structures.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Calculate shape factor and plastic moment capacity

CO2: Design eccentrically loaded compression members (Beam-Columns) and their base plates

CO3: Design welded plate girder and other components and Gantry girder

CO4: Carry out wind load calculations for tall structures and design of steel chimneys

Course Content

Unit I

Girder and roof trusses: Design of gantry girder, Design of roof trusses

Unit II

Design of plate girder: design of section, connections for flange plate to flange angles & flange angles to web, web and flange splicing. Vertical, Horizontal, Intermediate and Bearing stiffeners. Curtailment of plates.

Unit III

Bridges: Standard loading for railway bridges, design of Deck type plate-girder bridges, design of bracings and frames. Application of ILD to the design of bridges, design of through type truss bridges, design of members and joints, design of stringers, cross girder, lateral, sway and portal bracings.

Unit IV

Tanks: Water tanks, circular tanks with segmental bottoms, rectangular tanks, pressed steel tanks, design of staging

Recommended Books / Suggested Readings:

1. Limit state design of steel structures: S K Duggal
2. Design of steel structures: N Subramanian
3. Design of steel structures (Vol. 2): Ram Chandra
4. Design of steel structures: L S Negi
5. Design of steel structures (by limit state method as per IS: 800-2007): S S Bhavikatti
6. IS 800: 2007 (General construction in steel-Code of practice)*
7. SP: 6(1) (Handbook for structural engineers-Structural steel sections) IBH.
8. Limit state design of steel structures: S K Duggal
9. Design of steel structures: N Subramanian

BCE742: BRIDGE ENGINEERING
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the awareness of IRC loading respective to design of bridge. The course includes information about steel and concrete design.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Design the slab culvert, box culvert

CO2: Design the T-beam bridge and substructures

CO3: Design the bridge bearings

CO4: Design the steel bridge for railways.

Course Content

Unit I

Reinforced Concrete Bridges: IRC Loading and impact factors, Design and detailing of slab bridge IRC effective width method, Design and detailing of simply supported T-beam bridge (without footpath) - Pigeaud's method for design of slab panels and Courbon's method of lateral distribution of live load in main beams

Unit II

Design and detailing of single vent rectangular box culvert. Drawings: (For Class Work Evaluation only)
Plan, Elevation and section of reinforced concrete slab, T Beam Bridge and Box Culvert with reinforcement details and bar bending schedule.

Unit III

Steel Bridges: Introduction to steel bridges - deck and through types of bridges -economical spans - Indian standard broad gauge train loading - impact factor - permissible stresses, Design of railway plate girder - deck type of bridge for broad - gauge main line loading - wind bracing and cross frames - plate bearings

Unit IV

Design of railway through type truss bridge for broad gauge main line loading - design of various members including and post design of connections, Design of Piers and Abutments.

Recommended Books / Suggested Readings:

1. Ponnusamy S, "Bridge Engineering" Tata McGraw Hill Publishing Co., New Delhi
2. Whitney, C.S, Bridges, Greenwich House
3. Singh, V.P Wells and Caissons, Nemchand & Sons
4. Victor D.J - Essentials of bridge Engineering, Oxford and IBH Publishers.
5. Arya and Azmani - Design of steel structures, Nemchand Publishers.
6. I.R.C Codes, Railway bridge rules, Lucknow.
7. Ponnusamy S, "Bridge Engineering" Tata McGraw Hill Publishing Co., New Delhi

BCE743: STRUCTURAL DYNAMICS
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the dynamic response of SDOF and MDOF.

The course includes the study of continuous systems subjected to different types of dynamic loads and forced vibrations response of structural systems.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the concepts of dynamic systems

CO2: Identify, formulate and solve dynamic response of SDOF and MDOF.

CO3: Analyze continuous systems subjected to different types of dynamic loads.

CO4: Identify, formulate and solve free and forced vibrations response of structural systems.

Course Content

Unit I

Introduction: Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion- Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

Unit II

Fourier series: expression for loading - (blast or earthquake) - Duhamel's integral - Numerical evaluation - Expression for generalized system properties - vibration analysis Rayleigh's method - Rayleigh - Ritz method

Unit III

Differential equation of motion : Beam flexure including shear deformation and rotatory inertia - Vibration analysis using finite element method for beams and frames

Unit IV

Evaluation of structural property: matrices - Natural vibration - Solution of the eigen value problem - Iteration due to Holzer and Stodola**.** Idealization of multi-storeyed frames: analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system - Design of earthquake resistant structures

Recommended Books / Suggested Readings:

1) Mario Paz, Structural Dynamics, CBS, Publishers, 1987.
2) Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.
3) A.K. Chpora "Dynamics of Structures Theory and Application to Earthquake Engineering" Pearson Education, 2001.
4) Roy R Craig, Jr., Structural Dynamics, John Wiley & Sons, 1981.
5)

BCE744: RAILWAY AND AIRPORT ENGINEERING
Credits: 3
LTP 300

Course Description: The course aims to equip the students with fundamentals and geometric design of railway engineering.

The course includes fundamental and in-depth study of airport engineering.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Carry out the surveys for railways and airports.

CO2: Perform geometric design for the modes.

CO3: Plan the layout of different types of terminals.

CO4: Demonstrate the fundamentals of Intelligent Transportation Systems

Course Content

Unit I

Introduction to Railway Engineering: History of Railways, Development of Indian Railway, Organisation of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge. Railway Track: Requirements of a Good Track, Track Specifications on Indian Railways, Detailed Cross-Section of Single/Double Track on Indian Railways. Components of Railway Track: Rails, Sleepers, Ballast, Subgrade and Formation, Railway track in cutting & filling, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails. Geometric Design of Railway Track: Alignment, Gradients, Horizontal Curve, Superelevation, Equilibrium Cant, Cant Deficiency, Transition Curves. Points and Crossings: Functions, Working of Turnout, Various types of Track Junctions and their layouts, Level-crossing.

Unit II

Railway Stations & Yards: Site Selection, Classification & Layout of Stations, Marshalling Yard, Locomotive Yard, Equipment at Railway Stations & Yards. Signalling and Interlocking: Objectives, Classification of Signals, Types of Signals in Stations and Yards, Automatic Signalling, Principal of Interlocking. Modernization of Railway Tracks: High Speed Tracks, Improvement in existing track for high speed, Ballastless Track, MAGLEV, TACV Track.

Unit III

Introduction to Airport Engineering: Air Transport Scenario in India and Stages of Development, National and International Organizations. Airport Planning: Aircraft Characteristics, Factors for Site Selection, Airport Classification, General Layout of an Airport. Obstructions and Zoning Laws, Imaginary Surfaces, Approach Zones and Turning Zones. Runway Orientation and Design: Head Wind, Cross Wind, Wind Rose Diagram, Basic Runway Length, Corrections, Geometric Design Elements, Runway Configuration. Taxiway and Aircraft Parking: Aircraft Parking System. Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons. Visual Aids: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR

Unit IV

Urban transportation systems - Bus transit - Mass Rapid Transit System - Light Rail Transit. Transport economics and Financing - Intelligent Transportation Systems (ITS)

Recommended Books / Suggested Readings:

1) Railway Engineering by Chandra S., and Aggarwal, M.M. Oxford University Press, New Delhi, 2007.
2) A Text Book of Railway Engineering Saxena, S.C., and Arora, S.P., Dhanpat Rai and Sons, Delhi, 1997.
3) Railway Track Engineering by J. S. Mundrey, , McGraw Hill Publishing Co., 2009
4) Airport Planning and Design by Khanna, S.K., Arora, M.G., and Jain, S.S, Nem Chand & Bros. Roorkee, 1999.
5) Planning and Design of Airports by Horenjeff, R. and McKelvey, F, McGraw Hill Company, New York, 1994.
6) Airport Engineering: Planning, Design and Development of 21st Century by Norman J. Ashford, Saleh Mumayiz, Paul H. Wright, Wiley Publishers, 2011.

BCE745: URBAN PLANNING AND SUSTAINABLE DEVELOPMENT
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the knowledge about Urban planning and management, and sustainable developments in urban and transport sector

The course includes brief description about town planning concepts implemented in a sustainable manner.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the urban planning and management.

CO2: Understand and implement sustainable urban and transport principles

CO3: Use sustainable methods of construction in the urban region and the environment.

Course Content

Unit I

URBAN PLANNING AND DEVELOPMENT: Introduction-Definition of terms, Explanation of concepts, National policies and strategies on issues related to Urban development – Trends of Urbanization- Positive and Negative impacts of Urban Development Principles of planning – Types and levels of Urban plans, Stages in the planning process.

Unit II

DEVELOPMENT PLANS, FORMULATION & EVALUATION: Scope and content of Regional Plan, Master Plan, Detailed Development Plan, Structure Plan, Sub Regional Plan, DCR planning and developments of industrial estates, SEZ, Development strategies, formulation and evaluation.

Unit III

PLAN IMPLEMENTATION AND URBAN MANAGEMENT: Constraints for plan implementation – Industrial, Financial and Legal Constraints, Institutional Arrangements for Urban Development – Financing of Urban Developments - Decision Support System for Urban Management – Involvement of public, private, NGO, CBO & Beneficiaries. Urban Environmental Sustainability, Urban Sustainable Development, Methods and Tools for Sustainable Appraisal, Sustainable Transportation – Principles, indicators and its implications Environment and Resources- Economic Benefits of Sustainable Transportation

Unit IV

URBAN REGION AND ENVIRONMENT: Sustainability Assessment, Future Scenarios, Shape of Urban Region, Managing the change, Integrated Planning, Sustainable Development- City Centre, Development Areas, Inner City Areas, Suburban Areas, Periurban and Country side, Economy and Society.

Recommended Books / Suggested Readings:

1. Goel .S.L Urban, "Development and Management", Deep and Deep publications, New Delhi,2002

BCE746: DESIGN AND CONSTRUCTION OF PAVEMENT
Credits : 3
LTP 300

Course Description: The course aims to equip the students with the understanding of the analysis, design, construction and evaluation of the road pavements.

The course includes detailed description about pavement materials, construction material and analysis of flexible and rigid pavement.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand different loading conditions and design parameters of pavements

CO2: Design overlay and evaluate pavement.

Course Content

Unit I

PAVEMENT MATERIALS AND COMPONENTS: Bitumen – types and grades – properties and testing of materials – Types of granular and bituminous mixes- polymer modified bitumen, Geosynthetics- Cement – grades – chemical composition – hydration of cement – testing – admixtures – fibers - properties and testing of pavement quality concrete. Methods of construction and field control checks for various types of flexible pavement layers - methods of construction of Cement concrete pavements layers – joints - Excavators, graders, vibratory rollers, sensor pavers, computerized asphalt mix plant, plants and trucks for ready mix concrete, slip form paver – working principle, advantages and limitations

Unit II

ANALYSIS AND DESIGN OF FLEXIBLE PAVEMENT: Stresses and deflections in homogeneous masses – Analysis of flexible pavement, Bossinesq's theory, Burmister's theory- Various approaches of flexible pavement design methods - empirical, Semi-empirical method - IRC design method.

Unit III

ANALYSIS AND DESIGN OF RIGID PAVEMENTS: Stresses and deflections in rigid pavements – Westergaard's analysis, IRC design charts – wheel load stress, warping stress, frictional stress and combination of stresses – types of joints – Design of slab and joints – IRC method of design.

Unit IV

PAVEMENT EVALUATION AND STRENGTHENING: Method of pavement evaluation - Distresses in flexible pavements and rigid pavements - Structural evaluation of flexible and rigid pavements -Evaluation by deflection measurements- design of overlays

Recommended Books / Suggested Readings:

1. Yoder .E.J and Witezak, "Principles of Pavement Design", John Wiley and Sons, 2005.
2. "Standard Specifications and Code of Practice for Construction of Concre" Roads, IRC15-2002.
3. "Guidelines for the Design of flexible Pavements, Indian Road Congress", IRC 37-2001.

BCE747: REINFORCED EARTH AND GEOTEXTILES

Credits: 3

LTP 300

Course Description: The course aims to equip the students with the understanding of the mechanics of reinforced earth techniques and geosynthetic

The course includes study of reinforced earth, an overview of geosynthetics, natural & synthetic geotextiles in erosion control and designing with geotextiles.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the principle of reinforced earth and different types of reinforcement techniques.

CO2: Identify the types and functions of geosynthetics.

CO3: Compare the different geosynthetics products for different construction projects.

CO4: Identify the testing methods for geosynthetics.

CO5: Compare natural and artificial geosynthetics.

CO6: Design of paved and unpaved roads, embankments and retaining walls with different types of geosynthetics

Course Content

Unit I

Reinforced Earth – The mechanisms of the reinforced earth techniques – Design principles – Materials used for construction – Advantages of reinforced earth – Reinforced earth construction with GI sheets and strips.

Unit II

An overview of Geosynthetics, Description of Geotextiles – Geogrids – Geonets – Geomembranes –Geocomposites – Geocells –Geotextile properties and test methods –Functions of Geotextile – Methods for separation – stabilization – filtration – Drainage, Soil anchors, Application & Construction practices with Geotextiles, Geogrids, Geonets, Geomembranes.

Unit III

Natural & Synthetic Geotextiles in Erosion Control : Introduction, Jute, coir& Synthetic production, Status of Geotextiles industry in India, Physical and chemical characterization, durability of Geotextiles, Test procedures, role of vegetation, erosion control products and their classification, erosion process, surface erosion control techniques, installation guide lines for slopes

Unit IV

Designing with Geotextiles for retaining/earth wall, paved and unpaved roads, Embankments, Shallow foundations - Improvement in bearing capacity

Recommended Books / Suggested Readings:

1. Robert M. Koerner, Designing with Geosynthetics, Prentice Hall – 1989
2. G.V Rao & GVS Suryanarayana Raju, Engineering with Geosynthetics, Tata Mc Graw Hill Publishing Co. New Delhi
3. Korener, Construction & Geotechnical Methods in Foundation Engineering, McGraw Hill
4. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
5. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
6. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

BCE748: Soil Dynamics & Machine Foundation
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the skills to analyze the theory of vibrations to find the behavior of soil under dynamic loading and predict the influence of vibrations

The course includes the study of nature of dynamic loads, criteria for a satisfactory machine foundation, vertical, sliding, rocking and yawing vibrations of a block foundation and foundations subjected to impact loads

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Recognize the scope and significance of soil dynamics.

CO2: Apply the concept of theory of vibrations to find the behavior of soil under dynamic loading.

CO3: Understand vibration concepts in soils like damping, wave propagation, resonance and effect of
modes of vibrations

CO4: Employ the code of practice for design of foundations for reciprocating machines

CO5: Design foundations subjected to impact loads.

Course Content

Unit I

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism- type of machine foundations – special considerations for design of machine foundations - theory of vibration: general definitions – properties of harmonic motion - free vibrations of a mass-spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom - special response

Unit II

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants - methods of determination of soil constants in laboratory and field based on IS code provisions

Unit III

Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines – design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method)

Unit IV

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations – computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations

Note: Use of I.S 2974 Part I and II will be allowed in the university examination

Recommended Books / Suggested Readings:

1. Shamsher Prakash, Soil Dynamics, McGraw Hill
2. Das and Ramana, Principle of Soil Dynamica, Cengage Learning
3. Alexander Major, Dynamics in Soil Engineering
4. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
5. IS 2974 - Part I and II, Design Considerations for Machine Foundations *
6. IS 5249: Method of Test for Determination of Dynamic Properties Of Soils
7. IS code marked with * is permitted in examination.

BCE749: CONSTRUCTION ENGINEERING AND PROJECT MANAGEMENT
Credits: 3
LTP 300

Course Description: The course aims to equip the students with knowledge about Plan Bar Chart, material requirement schedule, Manpower schedule and Machinery Schedule.

The course includes brief description about plan Quality and Safety Checklist for the Construction Site the Construction Labor law for a project site.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the roles and responsibilities of a project manager

CO2: Prepare schedule of activities in a construction project and estimate rate analysis of excavation by excavator, concreting by Batching plant Concrete.

CO3: Use suitable type of machinery for their project site.

CO4: Prepare bar chart, material schedule, manpower schedule and machinery schedule.

Course Content

Unit I

Introduction: Construction as industry and its challenges, Role of construction management, Methods of construction managements, Basic requirements of construction management: Learning structures, Life cycle of construction projects: Examples of real projects and its learning requirements, time, activity & event, barchart, Milestone chart, uses & draw backs. PERT: Construction of PERT network, time estimates, network analysis, forward pass & backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems.

Unit II

CPM: Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance in project control, numerical problems. Analysis of Cost and Projects: Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems. updating a project, when to update, time grid diagram, resource scheduling. planning of different components of civil engineering projects such as a house, workshop, dam, tunnel**.**

Unit III

Construction Equipment and Machinery: Tractors, bull dozers, rippers, scrappers, power shovels, dragline, hoes. Line diagram of each, sizes, output, uses, factors affecting selection of each equipment, economic life of equipment, maintenance and repair cost. Hoisting & Transporting Equipment's: Hosts, Winches, Cranes, Belt conveyors, Ropeways, trucks & Wagons.

Unit IV

Various Construction Methods: Excavation, Earth-moving, Drilling, Blasting, Dewatering, foundation, finishing items, painting, flooring, brick works. Plants for grading, batching, mixing, types of mixers, concrete pumps, bitumen plants. Automation in construction industry: a general discussion

Recommended Books / Suggested Readings:

1. F. Harris, R. McCaffer and F. Edum-Fotwe, Modern Construction Management, Blackwell Publishing.
2. C. J. Schexnayder and R. E. Mayo, Construction Management Fundamentals, McGraw Hill, New Delhi.
3. Construction Planning and Equipment - R.L.Peurifoy - Tata McGraw Hill, New Delhi
4. PERT and CPM - L.S.Srinath, East West Press
5. Management Guide to PERT & CPM - Wiest & levy. Prentice Hall
6. Construction Equipment & Planning and Application. - Mahesh Verma Artec Publication.
7. Construction Planning and Management by U. K. Shrivastava. Galgotia Publications Pvt. Ltd.

BCE841: ESTIMATION AND COSTING PROFESSIONAL PRACTICES
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the understanding of estimating the cost of a building from given set of drawings and detailed specifications

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply different types of estimates in different situations

CO2: Carry out analysis of rates and bill preparation at different locations

CO3: Demonstrate the concepts of specification writing

Course Content

Unit I

Quantity Survey and Cost Estimation: Definitions, objectives, role and functions of quality surveyor, Pretender survey, Quantity measurements, analysis of rates for different items of work. Specifications, its types. General and detailed specifications for different items of work. Estimates and budgets types and their preparation. Estimate of Buildings, Roof Trusses, Roads, Culverts and canals. Building bye Laws.

Unit II

Contracts: Definition, need, importance, types of contracts and their characteristics, procedure for tendering and contracts, piecework agreement and work order evaluation and examination of tenders, award of work, Joint Ventures. Valuation, its types. Determination of value of a property, Calculation of standard rent. Definitions, Functions, characteristics of project, planning and principles of Planning and Management.

Unit III

Material Management: Importance, scope, objectives and functions, identification of source and vendor analysis, purchase procedure, inventory control, EOQ analysis, ABC Analysis, layout and storage of stores, safety in handling and precautionary measures, wastage and analysis of wastages. **Rate Analysis:** Purposes of Rate Analysis, Factors affecting, importance, Schedule of Rates, Task works per Day, Rate analysis of typical Items.

Unit IV

Valuation: Purposes, Cost, Price and Value, Forms of Value, Classification of Property, Freehold and Leasehold Properties, Sinking Fund, Amortization, Depreciation and Obsolescence, Outgoings, Gross Income and Net Income, Capitalized value, Deferred Land Value, Year's Purchase, Rate of Interest, Mortgage, Legal Mortgage, Accommodation Land and Accommodation Works, Annuity, Land Valuation, Methods of Land Valuation, Rent fixation. **Account Procedure of PWD Works**: Classification of Works, Muster Roll, Deposit works. Cash Book, Imprest, temporary Advance, MAS Account, Stores, Indent, Tools and Plants

Recommended Books / Suggested Readings:

3. Kohli D. D.; A Text book on Estimating and Costing and Accounts, S. Chand & Company NewDelhi.
4. Seetharaman S.; Construction Engineering and Management, Umesh Publication Delhi.
5. K.K. Chitkara, "Construction project management: planning, scheduling and controlling", Tata McGrawHill.
6. B. Sengupta and H Guha, "Construction management and planning", Tata McGraw Hill.
7. J. Singh, "Heavy ConstructonPlanning, equipment and methods", Oxford & IBH Publishing Co. Pvt.
8. Datta B. N.; Estimating and Costing in Civil Engineering, U.B.S. Publisher
9. J. Singh, "Heavy ConstructonPlanning, equipment and methods", Oxford & IBH Publishing Co. Pvt.
10. Datta B. N.; Estimating and Costing in Civil Engineering, U.B.S. Publisher

BCE842: Wastewater engineering
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the understanding of rural water supply , rural sanitation programs in India.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Choose sewer and their lying process suitable to Indian condition

CO2: Design, operation and maintenance of sewerage system.

CO3: Design of sewage treatment unit.

Course Content

Unit I

Introduction: Definition and Scope, types of sewer pipes and their laying and testing. Systems of sanitation and their merits and demerits, system of sewerage, choice of sewerage system and suitability to Indian conditions.

Sewerage System: Generation and Estimation of Community Sewage; Flow variations; Storm Water flow; Flow measurement in open channels; Alternate systems for sewage collection and conveyance; Drains and sewers types; Sewer appurtenances ; construction and Maintenance of sewers; Sewage pumping and pumping stations; Design, Operation and maintenance of sewerage systems.

Unit II

Characterization of Sewage: Parameters for characterization; Sampling, testing and analysis of sewage; Relative stability and population equivalent; BOD and BOD kinetics.

Treatment of Sewage: Basic principles of sewage treatment; Introduction to unit operations and processes primary treatment units such as screening, grit chamber, Floatation units; Sedimentation tanks, secondary treatment units such as different types of aerobic suspended and attached growth systems, and tertiary treatment for polishing, nutrient removal and disinfection; Sludge Handling and disposal – thickening, stabilization, dewatering, drying and disposal.

Unit III

Sewage Treatment Units Design: Design of grit chamber, primary and secondary clarifiers, ASP, TF, stabilization ponds and oxidation ponds Treated Effluent Disposal: Disposal into surface water bodies; Reuse for irrigation and aqua culturing, Land disposal, Disposal through injection into groundwater, effluent standards. Low Cost Sanitation Systems - Imhoff tanks, septic tank soakage pit/soil absorption systems, stabilization ponds, macrophyte ponds, oxidation ponds and constructed wetland systems.

Unit IV

Plumbing: Sewer connections for houses and buildings; Traps, sanitary fittings & fixtures, typical lay out for a residence. Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management, reuse/ recycle energy recovery, treatment and disposal.

Recommended Books / Suggested Readings:

1) Garg S. K.; Environmental Engineering Vol. II, Khanna Publishers New Delhi
2) H. S Peavy, D. R. Rowe & George Tchobanoglous, "Environmental Engineering", McGrawHill
3) Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi.
4) P.N. Modi; Sewage Treatment and disposal & Waste Water Engineering, Standard Book House New Delhi
5) Metcalf & Eddy, "Wastewater Engineering Treatment and Reuse," Tata McGraw Hill.
6) Clair N Sawyer & Perry L McCarty, G. F. Parkin, "Chemistry for Environmental Engineers", McGrawHill.
7) Standard Methods for the Examination of Water and Waste Water, American Public Health Association

BCE843: PRE-STRESSED CONCRETE ENGINEERING
Credits: 3
LTP 300

Course Description: The course aims to equip the students with the knowledge of design concepts and analysis of pre stressing materials

The course includes information about steel and concrete design.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand the concepts of pre-stressing in concrete structures and identify the materials for pre-stressing

CO2: Design pre-tensioned and post tensioned girders for flexure, bond and shear

CO3: Analyze a pre-stressed concrete member for deflection.

Course Content

Unit I

Introduction-Principles of Pre-Stressing-Materials-Losses-Systems of pre-stressing-Simple cable profiles-Load balancing method.

Unit II

Pre-Tensioned and Post-Tensioned Beams-Principles of designs-Design for flexure, bond and shear – IS Code provisions-Ultimate Strength of pre-stressed concrete beams in flexure and shear- Design of end anchorage Zones using I S Code method.

Unit III

Deflection of Pre-Stressed Concrete Members: Methods of pre-stressing-principles of partial pre-stressing–non-pre-stressed reinforcements

Unit IV

Composite beams: Analysis and Design of composite beams.

Recommended Books / Suggested Readings:

1. Krishna Raju, N., Prestressed Concrete Structures, Tata McGraw Hill.
2.Dayaratnam. P. Prestressed Concrete Structures, Oxford & I B H Manual on sewerage and sewage treatment, Ministry of Urban Development, New Delhi.

BCE844: EARTHQUAKE RESISTANT STRUCTURES
Credits: 3
LTP 300

Course Description: The course aims to equip the students with various aspects of seismology and design concepts of machine foundation

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Apply the basics of Earthquake Engineering

CO2: Demonstrate the dynamics of structural system under earthquake load

CO3: Analyze the influence of the structural / geometrical design in building characteristics

CO4: Demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements

Course Content

Unit I

Introductory Seismology: Various terminology related with earthquake, Causes of earthquake, plate tectonics, Tsunami. Seismic wave propagation. Magnitude, intensity & energy of earthquake, magnitude & intensity scales, classifications of earthquakes, Seismic zoning case histories of earthquakes. Seismic hazards, induced hazards.

Unit II

Earthquake recording: Seismic instruments, Seismographs & Seismograms. Basic concept of liquefaction and isolation. Introduction to various IS related codes. Structural systems, Effects of earthquake on buildings in general, structural and nonstructural failures. Dynamic characteristics of buildings, natural period of vibration, damping, stiffness etc. Seismic performance of traditionally built masonry constructions, typical failure mechanism of masonry buildings under earthquakes.

Unit III

Introduction to IS 4326: 1993: Planning consideration & architectural concept, provisions for earthquake resistant construction/ seismic strengthening of masonry constructions. **Introduction to IS 13920: 1993:** Seismic performance of reinforced concrete buildings. Plan, elevation & stiffness irregularities & their effects. Typical earthquake damages of RC constructions, short column effect, soft storey effect, strong column-weak beam analogy. IS 13920: 1993: Ductile detailing of reinforced concrete buildings and shear wall concept.

Unit IV

Introduction to IS 1893 (part I):2002: Seismic design philosophy, IS 1893 (part I):2002 codal provisions : Load combinations, Design lateral loads, response reduction factors, structural modeling of building frames, equivalent load method for earthquake analysis of multistory frames. **Design of foundations for reciprocating and impact machines:** Analysis of Two Degree freedom systems under free and forced vibrations -Principles of Design of Foundations for reciprocating and impact machines as per IS code.
Vibration isolation: Types and methods – Isolating materials and their properties.

Recommended Books / Suggested Readings:

1. Earthquake Resistant Design of Structures, Pankaj Agrawal, 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, South Asian Publishers.
7. IS 1893-2002 Indian Standard Criteria for Earthquake Resistant Design of Structures.
8. IS 4326-1993 2002 Indian Standard for Earthquake Resistant Design and Construction of Buildings.
9. IS 13920-1993 2002 Ductile detailing of Reinforced Concrete Structures subjected to Seismic Forces.
10. Barkan, "Dynamics of Bases and Foundations", 2nd Edition McGraw Hill Publishing, 1970.
11. Shamsher Prakash, "Soil Dynamics", 3rd Edition, John Wiley, 2000.

BCE845: GROUND IMPROVEMENT TECHNIQUES
Credits: 3
LTP 300

Course Description: The course aims to equip the students with analytical and practical knowledge about various methods of the improvement of soil.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Identify ground condition and suggest method of improvement
CO2: Design and assesse the degree of improvement
CO3: understand the principal of soil reinforcement and confinement in engineering construction
CO4: Design reinforced soil structure

Course Content

Unit I

Introduction to soil improvement techniques- dynamic compaction equipment used - application to granular soils, cohesive soils, depth of improvement, environmental considerations, induced settlements, compaction using vibratory probes, vibro techniques-vibro equipment, the vibro compaction and replacement process, control of verification of vibro techniques, vibro ystems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction introduction to bio technical stabilization.
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Unit II

Soil improvement using admixtures: lime stabilization, lime column method, stabilization of soft clay or silt with lime, bearing capacity of lime treated soils, settlement of lime treated soils, improvement in slope stability, control methods, chemical grouting, commonly used chemicals, grouting systems, grouting operations, applications, compaction grouting: introduction application and limitations, plant for preparing grouting materials, jet grouting, jet grouting process, geometry and properties of treated soils, applications, slab jacking, gravel, sand, stone columns.

Unit III

Soil improvement using reinforcing elements: introduction to reinforced earth, load transfer mechanism and strength development, soil types and reinforced earth, anchored earth nailing reticulated micro piles, soil dowels, soil anchors, reinforced earth retaining walls.

Unit IV

Geotextiles: Behaviour of soils on reinforcing with geotextiles, effect on strength, bearing capacity, compaction and permeability, design aspects, slopes, clay embankments, retaining walls, pavements.

Recommended Books / Suggested Readings:

1) Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall
2) Boweven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3) Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thoma Telford
4) Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5) Donald .H. Gray & Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6) Rao G.V. & Rao G.V.S., Text Book On Engineering With Geotextiles, Tata McGraw Hill
7) Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill

BCE846: REPAIR AND REHABILITATION OF STRUCTURES
Credits : 3
LTP 300

Course Description: The course aims to equip the students with knowledge about the diagnosis, assessment and material application relating to maintenance and rehabilitation of structures

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Understand and analyze performance of different types of concrete structures

CO2: Diagnosis of distress and evaluation of its extent

CO3: Evaluation of strengthening and demolition of structural components.

Course Content

Unit I

General aspects: Performance of construction materials and components in services for strength permeability, thermal properties and cracking effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, Effects of cover thickness

Unit II

Maintenance and diagnosis of failure: Definitions **:** Maintenance, Repair and rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive measures based on various aspects of inspection- Assessment procedure for evaluating a damaged structure. Diagnosis of construction failures.

Unit III

Diagnosis and their remedies: Corrosion damage of reinforced concrete, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection, rust eliminators. Causes of deterioration of concrete, steel, masonry and timber structures, surface deterioration, efflorescence, causes, prevention and protection.

Unit IV

Materials and techniques of repair: Special concrete and mortar, concrete chemicals, expansive cement, polymer concrete sulphur infiltrated concrete, Ferro cement, fiber reinforced concrete. Methods of repair in concrete, steel, masonry and timber structures. Gunite and shotcrete, expoxy injection.

Recommended Books / Suggested Readings:

A. Shetty .M.S,"Concrete, Technology, Theory and Practice", S.Chand and Company, New Delhi 2005
B. Raiker .R.N, "Learning from Failures, Deficiencies in Design, Construction and Service", - R&D Centre (SDCPL), Raikar Bhavan, Bombay 1987.

BCE847: ADVANCED IRRIGATION ENGINEERING
Credits : 3
LTP 300

Course Description: The course aims to equip the students with knowledge about the designing aspect of hydraulic structures.

Course Outcomes (CO):

Upon successful completion of the course, the students should be able to:

CO1: Design weirs on pervious foundation

CO2: Design gravity dam and earthen dam

CO3: Design the canal systems and canal falls

CO4: Analyze open channels

Course Content

Unit I

Head Works: Types of head works, Functions of a diversion, component parts & design considerations of head works, silt control devices. Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.

Unit II

Design of Hydraulic Structures: Weirs versus barrage, types of weirs, main components of weir, and causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage and weir. Use of hydraulic jump in energy dissipation, Types of energy dissipaters and their hydraulic design. **Canal Regulators**: Off take alignment, cross-regulators – their functions and design, Distributary head regulators, their design, and canal escape. Necessity and location, types of falls and their description, selection of typeof falls, Principles of design, Design of Sarda type, straight glacis and Inglis or baffle wall falls.

Unit III

Cross-Drainage Works: Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing.
Canal Out-lets essential requirements, classifications, criteria for outlet behaviors, flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets.

Unit IV

Introduction to Open Channel Flow- Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Recommended Books / Suggested Readings:

1. Irrigation Engg. & Hydraulic Structure by Santosh Kumar Garg, Khanna Publishers
2. Design of Irrigation Structures by R.K. Sharma, Oxford IBH Pub
3. Irrigation Engg. and Hydraulics Structures by S.R. Sahasrabudhe, . Katson Publishing
4. Irrigation Practice and Design Vol. I to VII by K.B. Khushlani. Oxford IBH Pub
5. P.N. Modi. Irrigation with Resources and with Power Engineering, Standard Book House