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New Scheme & Syllabus Based on AICTE Flexible Curricula **(B. Tech)**
**Civil Engineering Department**

Scheme for fifth Semester

| S.No. | Course Code | Course Title | Hrs./ Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1 | PCC – CE501 | Structural Analysis-II | 2 | 1 | 2 | 4 |
| 2 | PCC – CE502 | Design of RCC Structures | 2 | 1 | 2 | 4 |
| 3 | PCC – CE503 | Transportation Engineering | 3 | - | 2 | 4 |
| 4 | PCC – CE504 | Water Resources Engineering | 3 | 1 | - | 4 |
| 5 | PCC – CE505 | Estimating & Costing in Civil Engineering | 2 | 1 | 2 | 4 |
| 6 | OEC – CE501 | Open Elective-I | 3 | - | - | 3 |
| 7 | PROJ – CE501 | Seminar-I | - | - | 2 | 1 |
| 8 | LC-CE501 | Design Studio-II | - | - | 4 | 2 |
| **Total Credits** | | | | | | **24** |

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| PCC – CE501 | Structural Analysis-II | 2L:1T:2P (5hrs) | 4 Credits |
|---|---|---|---|

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** To provide a base for structural design. For evaluating whether a structure will be able to withstand external forces and internal stresses & to determine the root cause of structural failure

**Module 1 Moment Distribution Method (WITH SWAY) and Kani's Method (6 Hrs)**

Application of MDM to Portal Frames taking SWAY into account, analysis of box frames, analysis of portals with inclined members, analysis of beams and frames by Kani's Method

**Module 2 Plastic Analysis (8 Hrs)**

Stress-Strain curve of steel, Plastic Theory of analysis, Its Comparison with Elastic Theory, Concept of Plastic Hinge Formation, Static and Kinematic Method of Plastic Analysis applied to beams and frames

**Module 3 Analysis of Tall Frames (8 Hrs)**

Approximate Methods (Portal Method, Cantilever Method), Factor Method, Substitute Frame Method

**Module 4 Matrix Method of Structural Analysis (14 Hrs)**

Flexibility Matrix Method applied to Beams, Trusses and Frames Stiffness Matrix Method applied to Beams, Trusses and Frames

**Module 5 Arches and Suspension Cables (10 Hrs)**

Three-Hinged and Two-Hinged Arches, Parabolic and Semi Circular Arches, Fixed Arches, Influence Lines, Rib Shortening and Temperature Effects, Suspension Cables

**Course Outcomes:**

Students will be able to

CO1 To inculcate the further analysis of structures undergoing sway using Moment Distribution Method and Kani's Method

C02 To understand the fundamentals of plastic analysis and use the same for analysis of beams and frames; to perceive the difference from elastic analysis of structures

CO3 To introduce the concepts of Approximate Methods of Analysis applied to frames undergoing the action of horizontal and vertical loads

CO4 To analyze indeterminate structures by matrix methods

CO5 To implement the envisaging of two and three hinged arches, fixed arches and assimilate their evaluation

**Text Books:**

1. Ramamrutham , S., Narayan, R., "Theory of Structures", Dhanpat Rai Publishing Company
2. Bhavikatti, S. S., "Structural Analysis-I", Vikas Publishing House Pvt. Ltd.
3. Bhavikatti, S. S., "Structural Analysis-II", Vikas Publishing House Pvt. Ltd.
4. Reddy, C. S., "Basic Structural Analysis", Tata McGraw Hill Publishing Company Limited
5. Weaver, W., Gere, J.M., "Matrix Methods of Framed Structures", CBS Publishers and Distributors, Delhi

**Reference Books:**

1. Wang, C. K., "Intermediate Structural Analysis", Tata McGraw Hill Publishing Company Limited
2. Utku , S., Norris, C. H., Wilbur, J. B., "Elementary Structural Analysis", Tata McGraw Hill Publishing Company Limited
3. Kinney Stering, J., "Indeterminate Structural Analysis", Addison Wesley
4. Hibbeler, R.C., "Structural Analysis" Pearson Education Publication

**Suggested List of Experiment:**

1. To study Two-Hinged (Parabolic arch and Semi-Circular)

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| | | | |
|---|---|---|---|
| **PCC-CE502** | **Design of Reinforced Concrete Structures** | **2L:1T:2P (5hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** Students will be able to understand proper load transfer mechanism of a RC frame structure along with proper understanding of design philosophies and will be able to design and detail all structural members such as beams, slab, column, footing and staircase and retaining wall.

**Module 1 Design philosophies and Analysis (10Hrs)**

Design philosophies of RC structures (WSM, LSM), Structural elements, Loads on structures, Various properties of concrete and reinforcing steel, partial safety factor for load and material, Role of structural engineer, RC sections in flexure - theory & analysis - singly and doubly reinforced - rectangular and flanged sections, Partial load factors.

**Module 2 Design of Slabs (10 Hrs)**

One way and Two way - simply supported, cantilever and continuous, yield line theory,

**Module 3 Design of Beams (10Hrs)**

Design of beams for flexure, shear, bond and torsion: simply supported, continuous & cantilever, redistribution of moments in continuous beam, Doubly reinforced beam, Flanged beam, Design of Deep beams.

**Module 4 Design of Columns and Footings (10 Hrs)**

Short & long - axially loaded, uniaxial & biaxial moments. Square, Rectangular and Circular columns. Isolated and combined footings, Strap footing, Columns subjected to axial loads and bending moments (sections with no tension), Raft foundation.

**Module 5 Design of staircase (08Hrs)**

Dog legged and open well having equal and unequal flights, Slabless tread-riser staircase.

**Course Outcomes:**

Students will be able to

CO 1. Able to understand the general mechanical behavior of reinforced concrete in accordance with IS 456:2000. Understanding of proper load transfer mechanism along with design philosophies and role of structural engineer. Able to design for collapse and serviceable conditions.

CO2. Able to analyze and design with detailing of different slabs.

CO3. Able to analyze and design with detailing for different beams.

CO4. Able to analyze and design with detailing of reinforced concrete compression members & footings.

CO5. Able to analyze and design with detailing of different type of staircase.

**Text/Reference Books:**

1. Shah V. L. and Karve S. R."Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune, 2005.
2. Punmia B. C., Jain A. K. and Jain A. K. "Limit State Design of R.C. Structures", Laxmi Publications Pvt. Ltd., 2015
3. S Unnikrishna Pillai and Devdas Menon "Reinforced Concrete Structures" Tata McGraw Hills Publications Third Edition.

**Suggested Lab Work**

1. Drawing of beams – simply supported, cantilever, continuous and doubly reinforced beam.
2. Drawing of slabs – one way and two way slabs.
3. Drawing of Staircase – Dog legged, Open well and Folded plate staircase.
4. Drawing of column.
5. Drawing of Footing – Isolated and combined footing

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| PCC-CE503 | Transportation Engineering | 3L:0T:2P (6hrs) | 4 Credits |
|---|---|---|---|

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** To provide fundamental knowledge of various conventional and modern planning & design techniques used for highway planning, pavement construction & airport engineering.

**Module 1 High way planning, Alignment & Geometric Design (10Hr)**

Principles of highway planning, road planning in India and financing of roads, classification patterns. Requirements, Engg. Surveys for highway location. Cross sectional elements- width, camber, super-elevation, sight distances, extra widening at curves, horizontal and vertical curves, numerical problems.

**Module 2 Bituminous & Cement Concrete Payments (10Hr)**

Design of flexible pavements, design of mixes and stability, WBM, WMM, BM, IBM, surface dressing, interfacial treatment- seal coat, tack coat, prime coat, wearing coats, grouted macadam, bituminous concrete specification, construction and maintenance. Advantages and disadvantages of rigid pavements, general principles of design, types, construction, maintenance and joints, dowel bars, tie bars. Brief study of recent developments in cements concrete pavement design, fatigue and reliability.

**Module 3 Low Cost Roads, Drainage of Roads, Traffic Engg. & Transportation Planning (10Hr)**

Principles of stabilization, mechanical stabilization, requirements, advantages, disadvantages and uses, quality control, macadam roads-types, specifications, construction, maintenance and causes of failures. Surface and sub-surface drainage, highway materials: properties and testing etc. Channelised and unchannelised intersections, at grade & grade separated intersections, description, rotary-design elements, advantages and disadvantages, marking, signs and signals, street lighting. Principles of planning, inventories, trip generation, trip distribution, model split, traffic assignment, plan preparation.

**Module 4 Airport Planning, Runway & Taxiway (10Hr)**

Airport site selection. air craft characteristic and their effects on runway alignments, windrose diagrams, basic runway length and corrections, classification of airports. Geometrical elements:

taxi ways and runways, pattern of runway capacity.

**Module 5 Airport, Obstructions, Lightning & Traffic control (10Hr)**

Zoning regulations, approach area, approach surface-imaginary, conical, and horizontal. Rotating beacon, boundary lights, approach lights, runway and taxiway lighting etc. instrumental lending system, precision approach radar, VOR enroute traffic control.

**Course Outcomes:**

CO1 Knowledge of standard procedures used to design principal elements of the highway alignment, and highway cross sections.

CO2 To understand the process of construction of different types of roads and the materials involved in its construction. Also to know the standard laboratory testing procedures of the materials.

CO3 To introduce the fundamentals of traffic and transportation planning with emphasis on intersections.

CO4 To have a basic understanding of the layout of airports, the geometric elements and design factors.

CO5 To perceive the importance of air traffic control and understand the different methods of the same.

**List of Experiments:**

1. Aggregate Crushing Value Test
2. Determination of aggregate impact value
3. Determination of Los Angeles Abrasion value
4. Determination of California Bearing Ratio values
5. Determination of penetration value of Bitumen
6. Determination of Viscosity of Bituminous Material
7. Determination of softening point of bituminous material
8. Determination of ductility of the bitumen
9. Determination of flash point and fire point of bituminous material
10. Determination of Bitumen content by centrifuge extractor
11. Determination of stripping value of road aggregate

12. Determination of Marshall stability value for Bituminous mix

13. Determination of shape tests on aggregate

**Reference Books:**

1. Highway Engineering by Gurucharan Singh

2. Principles of Pavement Design by E.J. Yoder & M.W. Witzech

3. Highway Engineering by O'Fleherty

4. Highway Engineering by S.K. Khanna & C.E.G. Justo

5. Airport Planning & Design by S.K. Khanna & M. G. arora

6. Foresch, Charles "Airport Planning"

7. Horonjeff Robert "The Planning & Design of Airports"

8. Sharma & Sharma, Principles and Practice of Highway Engg.

9. Haung, Analysis and Design of Pavements

10. Relevant IRC & IS codes

11. Laboratory Mannual by Dr. S.K. Khanna

12. Highway Engg. By Hews & Oglesby

13. Highway Material by Walker

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| | | | |
|---|---|---|---|
| **PCC – CE504** | **Water Resources Engineering** | **3L:1T:0P (4hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** The objective of this course is to fulfill the essential knowledge of water resources, hydrology of surface & ground water, irrigation requirement, flood estimation and introduction of hydraulic structures.

**Module 1 Hydrology** **(10 Hrs)**

Hydrological cycle, precipitation and its measurement, recording and non recording rain gauges, estimating missing rainfall data, rain gauge net works, mean depth of precipitation over a drainage area, mass rainfall curves, intensity-duration curves, depth-area duration curves, Infiltration and infiltration indices, evaporation stream gauging, run off and its estimation, hydrograph analysis, unit hydrograph and its derivation from isolated and complex storms, S-curve hydrograph, synthetic unit hydrograph.

**Module 2 Irrigation water requirement and Soil-Water-Crop relationship** **(10 Hrs)**

Irrigation, definition, necessity, advantages and disadvantages, types and methods. Irrigation development. Soils - types and their occurrence, suitability for irrigation purposes, wilting coefficient and field capacity, optimum water supply, consumptive use and its determination. Irrigation methods surface and subsurface, sprinkler and drip irrigation. Duty of water, factors affecting duty and methods to improve duty, suitability of water for irrigation, crops and crop seasons, principal crops and their water requirement, crop ratio and crop rotation, intensity of irrigation.

**Module 3 Ground Water and Well irrigation** **(10 Hrs)**

Confined and unconfined aquifers, aquifer properties, hydraulics of wells under steady flow conditions, infiltration galleries. Ground water recharge-necessity and methods of improving ground water storage. Water logging-causes, effects and its prevention. Salt efflorescence causes and effects. Reclamation of water logged and salt affected lands. Types of wells, well

construction, yield tests, specific capacity and specific yield, advantages and disadvantages of well irrigation.

**Module 4 Canals and Structures (10 Hrs)**

Types of canals, alignment, design of unlined and lined canals, Kennedy's and Lacey's silt theories, typical canal sections, canal losses, lining-objectives, materials used, economics. Introductions to Hydraulic Structures viz. Dams, Spillways, Weirs, Barrages, Canal Regulation Structures.

**Module 5 Floods & Water resources planning and management (10 Hrs)**

Types of floods and their estimation by different methods, probability and frequency analysis, flood routing through reservoirs and channels, flood control measures, economics of flood control.

Water resources in India, Planning of water resources projects, data requirements, economic analysis of water resources projects appraisal of multipurpose projects, use of GIS for Water Resources.

**Course Outcomes:**

Students will be able to

CO 1. To understand the hydrology, rainfall runoff process and its determination.

CO 2. To know the basics of irrigation, methods of irrigation water and soil-water-crop relationship.

CO3. To illustrate the hydraulics of ground water & well, ground water recharge and water logging.

CO 4. To realize the theories, Design of canal and introduction of hydraulic structures.

CO 5. To estimate flood by different methods, flood routing, flood control measures and water resources planning and management.

**Text/Reference Books:**

1. K. Subhramanya, "Engineering Hydrology",Tata Mc Graw Hills Publ. Co, 4th Edition.

2. S. K. Garg, "Hydrology and Water Resources Engineering",16 th Edition, 2005.
3. H.M. Raghunath, "Engineering Hydrology" new age publishers.

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| PCC – CE505 | Estimating Costing | 2L:1T:2P (5hrs) | 4 Credits |
|---|---|---|---|

**Pre-requisite(s) –** Basic Civil Engineering

**Objective:** To study about types of estimation, how to prepare detailed estimate of a project, complete process of tendering, contracts, rate analysis and valuation of construction project.

**Module 1 Introduction (10Hrs)**

Purpose and importance of estimates, principles of estimating. Methods of taking out quantities of items of work. Mode of measurement, measurement sheet and abstract sheet; bill of quantities. Types of estimate, plinth area rate, cubical content rate, preliminary, original, revised and supplementary estimates for different projects.

**Module 2 Tender (10Hrs)**

Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and items, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc

**Module 3 Measurements for various items (10Hrs)**

Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work and Preparing detailed estimates of various types of buildings, R.C.C. works and earth work, Bar bending schedules, Mass haul Diagrams,

**Module 4 Rate analysis (8Hrs)**

Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment Current schedule of rates (C.S.R.).

**Module 5 Valuation (8Hrs)**

Purposes, depreciation, sinking fund, scrap value, year's purchase, gross and net income, dual rate interest, methods of valuation, rent fixation of buildings.

**Course outcome:**

Student will be able to

CO 1. Understand the importance of estimation and to know the various types of estimation and prepare the bill of quantity

CO 2. Understand about the process of tendering and types of contracts, settlement of dispute and various term involving in the construction tendering.

CO 3. Prepare the detailed estimate of building, RCC work and earth work, bar bending schedule and mass haul diagram.

CO 4. Understand the purpose and importance of rate analysis and current schedule rate with determination of daily output from various equipments.

CO 5. Understand the purpose and methods of valuation and various term involve in the valuation of construction project like depreciation, sinking fund, scrap value, rent fixation of building etc.

**Text Books / Reference Books:**

1. B. N. Dutta, “Estimating And Costing in Civil Engineering” UBS Publishers' Distributors Pvt Ltd. 2016.
2. M Chakravarty, “Estimating, Costing Specifications & Valuation” Chakraborti 2006.
3. Joy P K, Handbook of “Construction Management” Macmillan Publishers India 2000.
4. B.S. Patil , “Building & Engineering Contracts” CRC Press 2019.
5. D.D. Kohli, Ar. R. C. Kohli “Textbook of Estimating and Costing (Civil)” S Chand Publishing 2013.

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Scheme For Six Semester

| S.No. | Course Code | Course Title | Hrs./ Week | | | Credits |
|---|---|---|---|---|---|---|
| | | | L | T | P | |
| 1 | PCC – CE601 | Design of Steel Structures | 2 | 1 | 2 | 4 |
| 2 | PCC – CE602 | Geotechnical Engineering | 2 | 1 | 2 | 4 |
| 3 | PCC – CE603 | Design of Hydraulic Structures | 3 | 1 | - | 4 |
| 4 | PCC – CE604 | Water Supply and Waste Water Engineering | 2 | 1 | 2 | 4 |
| 5 | OEC – CE601 | Open Elective-II (Humanities) | 3 | - | - | 3 |
| 6 | LC – CE601 | Design Studio-III | - | - | 4 | 2 |
| 7 | PROJ – CE601 | Internship (90 hrs) | - | - | - | 2 |
| **Total Credits** | | | | | | **23** |

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| | | | |
|---|---|---|---|
| **PCC – CE601** | **Design of Steel Structures** | **2L:1T:2P (5 Hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** To understand design philosophy related to basic steel and industrial structures.

**Module 1 Connections** **(10 Hrs)**

Structural properties of steel, Design of structural connections -Bolted, Riveted and Welded, Concentric and Eccentric connections.

**Module 2 Tension and Compression Members** **(10 Hrs)**

Design of compression member, Tension member, Roof truss-Angular and Tubular.

**Module 3 Built-up Columns and Foundations** **(10 Hrs)**

Design of columns-Simple and Compound, Lacing and Battens, Design of footing for steel structures, Grillage foundation.

**Module 4 Design for bending** **(10 Hrs)**

Design of simple beams, Built-Up beams Lattice girder, Plate girders and Gantry girders.

**Module 5 Industrial and Multi Storied Steel Structures** **(08 Hrs)**

Design of industrial building frames, Multi storey frames, Bracing for high rise structures.

**Course Outcomes:**

Students will be able to

CO1. Understand the behavior and undertake the design of bolted and welded connections between elements in simple configurations applying relevant codes of practice (IS: 800 - 2007).

CO2. Understand the behavior and undertake the design of structural steel members to resist tension, compression, bending & shear applying the relevant codes of practice (IS: 800 - 2007).

CO3. Understand the concept involved in steel column and foundation design.

CO4. Understand the behavior and undertake the design of girders and steel beam for bending.

CO5. Analyze the behavior of industrial and multi storey steel structural and undertake design at both serviceability and ultimate limit states.

**Text/Reference Books:**

1. N. Subramanian, Design of Steel Structures, Oxford Publications, 2008.
2. L.S. Negi, Design of Steel Structures, Mc Graw Hill Publication, 2017.
3. S. Ramamrutham, Design of Steel Structures, Dhanpat Rai Publiching Company.
4. S.K. Duggal, Design of Steel Structures, Mc Graw Hill Publication, 2019.
5. Ramchandra and V. Gehlot Design of Steel Structures-1, Scientific Publishers 13 Revision.

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|---|---|---|---|
| **PCC – CE602** | **Geotechnical Engineering-I** | **2L:1T:2P (5hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** The objective of this course is to introduce students with the essential concepts of the physical properties of soils as a civil engineering material and the fundamental principles of soil mechanics.

**Module 1 Properties of Soil** **(10 Hrs)**

Introduction–Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Three phase soil system, weight volume relationships, index properties of soil - methods of determination and its significance, classification of soil. Soil structure: single grained and honey combed, flocculated and dispersed. Plasticity Characteristics of Soil

**Module 2 Permeability and Seepage** **(10 Hrs)**

Permeability of Soil - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability by constant head and falling head method as per IS - 2720, field test as per IS – 5529 (part I) - pumping in test and pumping out test. Permeability of layered soils, Seepage forces, General flow equation. Flow net and its application. Seepage and seepage pressure .Effective Stress Principle - Introduction, effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quick sand condition.

**Module 3 Shear Strength of Soil and Stress Distribution in Soils** **(10 Hrs)**

A)Shear Strength Of Soil: - Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behavior of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters.

Unconfined compression test, vane shear test. Measurement of pore pressure, pore pressure parameters, critical void ratio, Liquefaction.

B) Stress Distribution in Soils:

Boussinesq theory- point load, pressure distribution due to line load, strip load, pressure bulb, Westergaard's theory, contact pressure, approximate stress distribution method.

**Module 4 Stability of Slopes (7 Hrs)**

Infinite and finite slopes. Types of slope failures, Rotational slips. Stability number. Effect of ground water. Selection of shear strength parameters in slope stability analysis. Analytical and graphical methods of stability analysis. Stability of Earth dams.

**Module 5 Lateral Earth Pressure (7 Hrs)**

Active, passive and earth pressure at rest. Rankine, Coulomb, Terzaghi and Culmann's theories. Analytical and graphical methods of determination of earth pressures on cosion-less and cohesive soils. Effect of surcharge, water table and wall friction. Arching in soils. Reinforced earth retaining walls.

**Course Outcomes:**

Students will be able to

CO1. To Understand the origin of the soil, geological cycle, Characterize and classification of soils.

CO2. To understand basics principles of flow and soil permeability through porous media including Bernoulli's equation, Darcy's Law, and Hydraulic conductivity.

CO3.To understand how stresses are transferred through soils and be able to compute both geostatic and induced stresses due to point, line, and area loads.

CO4.To understand the parameters which affect the stability of slopes and to solve real world problems.

CO5.Basic understanding of Lateral Earth Pressure concept and theory including Rankine theory of active and passive earth pressures with and without sloping backfill.

**Text/Reference Books:**

1. Dr. K.R. Arora, "Soil Mech. & Found. Engg." Std. Publishers Delhi.

2. Dr. B.C.Punmia, "Soil Mech. & Found" Laxmi Publications, Delhi.

3. Dr.l Aram Singh, "Modern Geotech Engg" IBT Publishers, Delhi.

4.. C. Venkatramaiah, "Geotech Engg" New Age International Publishers, Delhi

5. S.K. Garg, "Soil Mech. & Found. Engg." Khanna Publishers, Delhi.

6. T.W. Lambe, "Soil Testing for Engg" John Wiley & Soms. Inc.

7. Relevant I.S. Codes

**Suggested List of Experiment:**

1. Determination of Hygroscopic water content
2. Particle - size analysis
3. Determination of Specific gravity of soil particles
4. Determination of plastic limit
5. Determination of liquid limit
6. Determination of shrinkage limit
7. Permeability tests
8. Direct shear test
9. Triaxial compression test
10. Vane Shear test
11. The unconfined Compression Test

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|---|---|---|---|
| **PCC – CE603** | **Design of Hydraulic Structures** | **3L:1T:0P (4hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** The objective of this course is to fulfill the essential knowledge of water resources and skills in design of Hydraulic Structures.

**Module 1 Earth dams: (10 Hrs)**

Types of earth dam, causes of failure and design criteria, soils suitable for earth dam construction, construction methods, foundation requirements, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes by slip circle method of analysis, pore pressures, sudden draw down, steady seepage analysis, Types of rock fill dams, rock fill dam merits and demerits.

**Module 2 Gravity dams: (10 Hrs)**

Design Criteria, forces acting on gravity dams, elementary profile of dam, low and high gravity dams, stability analysis, evaluation of profile by method of zoning, practical profile, construction joints, and galleries in gravity dams.

**Module 3 Spillways: (08 Hrs)**

Ogee spillway and its design, siphon spillway, shaft spillway, chute spillway and side channel spillway, emergency spillways.

**Module 4 Energy dissipaters and gates: (10 Hrs)**

Principles of energy dissipation Energy dissipaters based on tail water rating curve and jump height curves Spillway crest gates (i.e. vertical lift gates and radial gates), their design principles and details. Design of canal regulating structures, detailed design of sarda falls, Types of cross drainage works, syphon aqueduct.

**Module 5 Hydropower Plants: (10 Hrs)**

Introduction of Hydropower development, types of hydropower plants, general features of hydro-

electric schemes, selection of turbines, draft tubes, surge tanks, penstocks, power house dimensions, pumped storage plants and their details.

**Course Outcomes:**

Students will be able to

CO1. To understand the design components of earth and rock fill dams and factors affecting the performance of these structures.

CO2. To develop concepts of construction and design of gravity dams.

CO3. To visualize and design of different types of spillways and their applications.

CO4. To understand the basic principles of energy dissipaters, gates and design concept of cross drainage works with their practical utility.

CO5. To understand the various components of a hydro power plant and their applications.

**Text/Reference Books:**

**1.** B.C. Punmia, "Irrigation and Water Power Engineering" Laxmi Publications (P) Ltd, 9th Edition, 2009.

**2.** Santosh Kumar Garg "Irrigation Engineering And Hydraulic Structures" Khanna Publications, 9th Edition, 2011**.**

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| | | | |
|---|---|---|---|
| **PCC – CE604** | **Water Supply and Waste Water Engineering** | **2L:1T:2P (Hrs)** | **4 Credits** |

**Pre-requisite(s) –** Basic Civil Engineering

**Objectives:** To offer knowledge of treatment,analysis of water and waste water, its properties and behavior under various situation of internal and external flows

**Module 1** **(10 Hrs)**

Estimation of ground and surface water resources. quality of water from different sources, demand & quantity of water, fire demand, water requirement for various uses, fluctuations in demand, forecast of population. Impurities of water and their significance, water-borne diseases, physical, chemical and bacteriological analysis of water, water standards for different uses. Intake structure, conveyance of water, pipe materials, pumps - operation & pumping stations.

**Module 2** **(10 Hrs)**

Water Treatment methods-theory and design of sedimentation, coagulation, filtration, disinfection, aeration & water softening, modern trends in sedimentation & filtration, miscellaneous methods of treatment. Sewerage schemes and their importance, collection & conveyance of sewage, storm water quantity, fluctuation in sewage flow, flow through sewer, design of sewer, construction & maintenance of sewer, sewer appurtenances, pumps & pumping stations.

**Module 3** **(10 Hrs)**

Characteristics and analysis of waste water, recycles of decomposition, physical, chemical & biological parameters. Oxygen demand i.e. BOD & COD, TOC, TOD, ThOD, Relative Stability, population equivalent, instrumentation involved in analysis, natural methods of waste water disposal i.e. by land treatment & by dilution, self purification capacity of stream, Oxygen sag analysis.

**Module 4** **(8 Hrs)**

Unit operations for waste-water treatment: Theory and design of preliminary treatment such as screens, grit chamber, sedimentation and chemical clarification, role of micro-organism in biological treatment.

**Module 5** **(10 Hrs)**

Methods of Biological Treatment (Theory & Design) –Trickling Filter, Activated Sludge process (ASP), Oxidation ditch, Septic tank & imhoff tank, theory of sludge. Diatomaceous earth filters, Ultra filtration, Adsorption by activated carbon, Phosphorus removal, Nitrogen removal

**Course Outcomes:**

Students will be able to

CO1. To estimate surface and ground water, quality, quantity and analysis of water, Intake structure.

CO2. Understand the types of water treatment methods, collection, construction & maintenance of sewer.

CO3 To understand the characteristics and analysis of waste water.

CO4. Theory, design of preliminary and operation for waste water treatment.

CO5. To perceive the theory & design of Biological Treatment .

**Text/Reference Books:**

1. B.C. Punmia, “Water Supply Engineering” Laxmi Publications Ltd, New Delhi
2. G.S. Birdi, “Water Supply & Sanitary Engineering” Laxmi Publications Ltd. New Delhi
3. S.K. Husain, “Water Supply & Sanitary Engineering”.
4. G.M. Fair & J.C. Geyer, “Water & Waste Water Technology”.
5. Relevant IS

**Suggested List of Experiment:**

1. To study of various standards of water, waste water & Sampling Techniques.

2. To determine the alkalinity of given sample of water.
3. To Determine the Dissolved Oxygen (D.O.) of the given water sample.
4. To determine the total hardness of given sample of water.
5. To determine the Concentration of Chloride of given water sample.
6. Measurement of Turbidity of the given water sample using turbidity meter
7. Calibration of turbidity meter using given sample
8. Application of pH meter to find acidity and alkalinity of the given solution
9. To determine the residual chlorine in given water sample
10. To perform Jar test for coagulation and to calculate the optimum dose of coagulation.