SEMESTER I

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Course)

201001 Building Technology and Architectural Planning

Credits: 3

Teaching Scheme:
Theory : 03hrs/week
Practical : 04 hrs/week

Examination Scheme:
In-semester : 30 Marks
End- semester : 70 Marks

Prerequisites:

Fundamentals of Engineering Graphics

Course Objectives:

1. To enumerate different types of structure and their requirement.
2. To describe all basic activities of construction.
3. To study different types of materials, byelaws and Architectural aspects used in construction for civil engineering projects.
4. To plan different building units, Town planning parameters and safety of buildings.

Course Outcomes:

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

1. Identify types of building and basic requirements of building components.
2. Make use of Architectural Principles and Building byelaws for building construction.
3. Plan effectively various types of Residential Building forms according to their utility, functions with reference to National Building Code.
4. Plan effectively various types of Public Buildings according to their utility functions with reference to National Building Code.
5. Make use of Principles of Planning in Town Planning, Different Villages and Safety aspects.
6. Understand different services and safety aspects

Course Contents

Unit I: Introduction to Building Construction and Masonry. (06 Hours)

a) Introduction to building construction– definition, types of building as per National Building Code. Building components and their basic requirements i.e substructure and superstructure requirements. Introduction to automation in construction

b) Masonry– Introduction of stone masonry and brick masonry, characteristics of good building bricks, IS specification and tests, classification of bricks, types of bonds: English, Flemish, Header, Stretcher, construction procedure, supervision. Recent trends in light weight construction

Form work and casting procedure for reinforced concrete columns, R.C.C. beams, R.C.C. slabs, Slip form work, introduction of underpinning and Scaffolding.

Unit 2: Building bye laws and introduction to Architectural drawing (06Hours)

a) Building Byelaws

Necessity of bye-laws, plot sizes, road width, open spaces, floor area ratio (F.A.R.), concept of

V.P.R. Marginal distances, building line, control line, height regulations, room sizes, Area calculations (built-up area, carpet area etc.), Rules for ventilation, lighting, Vertical circulation, Sanitation and Parking of vehicles.Minimum Standard Dimensions

b) Introduction to Architectural drawing :Principles of Building Planning and Principles of Architectural design relation between form and function, utility, aesthetics, Concept of Line plan, Developed Plan, Elevation, Section, Selection of scales for various drawings, dimensioning, abbreviations and symbols as per IS 962, Elements of perspective drawings, parallel and angular perspective of small building elements.

Unit 3: Building Components: **(06 Hours)**

a) Doors and Windows: Definition of technical terms, installation of doors and window frames and their size specifications, fixtures and fastenings. Different types of doorsand windows: Ventilators: purpose and types.

b) Arches and Lintels – Introduction of arch construction, **Lintels:** necessity and types, chajja or weather shade necessity and types.

Functional requirement of flooring, types of floor finishes and their suitability, Types of flooring.

Roofing Materials – galvanized iron pre-coated aluminium sheets, fiber sheets. Roof construction types and their suitability, method of construction, Protective Coatings with plastering and finishing.

Unit 4: Residential Buildings and green buildings **(06Hours)**

a) **Residential Buildings**- Functional requirements and dimensions of Residential Buildings like Bungalows, Twin bungalows, Row houses, Apartment. Prepare Developed Plan, Elevation and Sectional Elevation of above mentioned categories. Design of staircase : Dog legged /Quarter turn

b) **Green Building** -Salient features, benefits, planning concepts of Green Building (site selection, orientation, sun path and wind diagram etc.), introduction to Leadership in Energy and Environmental Design (LEED)

Unit 5: Planning of Public Buildings **(06Hours)**

Functional requirements and dimensions and planning of Public Buildings like industrial buildings, commercial buildings, School, Colleges , Hostel, Auditorium, Restaurant/ Hotel building, Primary Health Center/ Hospital, Shopping complex, Sports complex, Vegetable market, Post office, and Bank buildings.

Unit 6 (ONLINE): Town Planning and Legal Aspects: **(06 Hours)**

a) Town Planning and legal aspects: Necessity of town planning. Development plan and its importance, Land use zoning, N.A. Sanction procedure, Introduction to different zones of land in town planning, Aspects of zoning.7/12 abstract, meaning of different terms of 7/12 abstract, Form 6 and its types, Concept of TDR, List of documents to be submitted to local authority. , Introduction to RERA act. Introduction to Maharashtra Regional and Town Planning (MRTP) Act

b) Safety aspects and services –Fire load, grading of occupancies by fire loads, Evacuation Time, fire escape elements, Need for earthquake resistant structures.

Noise and Acoustics – Sound insulation, Acoustical defects, Reverberation time, Sabine's formula, sound absorbents, planning for good acoustics.

Ventilation – Necessity and types of Ventilation.

Lighting -Principles of day lighting,Solar energy systems for lighting (BIPV).
Plumbing –Types of plumbing system.

Books

Text books:

1. Building Construction by B.C. Punmia, Laxmi Publications.
2. Building Materials by S.V.Deodhar, Khanna Publication.
3. Building Construction by Bindra and Arora, DhanpatRai Publications.
4. Building Drawings with an integrated Approach to Built-Environment by M. G. Shah, C. M. Kale and S. Y. Patki, New Delhi, Tata McGraw Hill. (5th edition.)

Reference books:

1. Building Materials by S. K. Duggal, New Age International Publishers.
2. Building Construction by S.C. Rangwala, Charotdar Publications.
3. The construction of buildings; seventh edition, Vol.1 & Vol.2 by R. Barry, Oxford: Blackwell Science.
4. Building Materials Technology by Ruth T. Brantley & L. Reed Brantley, Tata McGraw Hill. 5. National Building Code (latest).
6. Building Design and construction by Frederick Merrit, Tata McGraw Hill.
7. I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings.
8. Development plan and DCP Rules of urban local body, New Delhi, Volume 12.

Savitribai Phule University of Pune
Second Year Civil Engineering (2019 Course)
201002 Mechanics of Structures

Credit : 3

Teaching Scheme:
Theory : 03hrs/ week
Practical : 04 hrs/week

Examination Scheme:
In-semester : 30 Marks
End-semester : 70 Marks

Prerequisites:
Fundamentals of Physics, Mathematics and Engineering Mechanics.

Course Objectives:
1. To study various types of stresses for determinate structural members.
2. To learn concept of Shear Force and Bending Moment Diagram for determinate beams.
3. To learn the concept of slope and deflection for determinate structural members.

Course Outcomes:
On completion of the course, learner will be able to:
1. Understand concept of stress-strain and determine different types of stress, strain in determinate, indeterminate homogeneous and composite structures.
2. Calculate shear force and bending moment in determinate beams for different loading conditions and illustrate shear force and bending moment diagram.
3. Explain the concept of shear and bending stresses in beams and demonstrate shear and bending stress distribution diagram.
4. Use theory of torsion to determine the stresses in circular shaft and understand concept of Principal stresses and strains.
5. Analyze axially loaded and eccentrically loaded column.
6. Determine the slopes and deflection of determinate beams and trusses.

Course Contents:

Unit I: Simple Stresses and Strains **(06 Hours)**

a) Materials used in construction and their nature, Hook's Law, Stress-Strain Diagram for elastic, plastic materials and brittle material, Idealized stress-strain diagram , Concept of axial stresses (compression, tension), strains(linear, lateral, shear and volumetric), Elastic constants and their relations. Stresses and strains due to change in temperature.

b) Stresses, strains and deformations in determinate and indeterminate structures for homogeneous and composite structures under concentrated loads and temperature changes.

Unit II: Shear Force and Bending Moment Diagram **(06Hours)**

Concept of shear force and bending moment. Relation between shear force, bending moment and intensity of loading. Shear force and bending moment diagrams for determinate beams due to concentrated, uniformly distributed, uniformly varying loads and couples. Bending moment and loading diagram from given shear force diagram.

Unit III: Shear and Bending Stresses **(06Hours)**

a) Shear stresses in beams: concept of shear, complimentary shear, derivation of shear stress formula, shear stress distribution for various cross sections, maximum and average shear stress for circular and rectangular sections.

b) Bending stresses in beams: theory of simple or pure bending, assumptions, derivation of flexure formula, bending stress distribution diagrams, Moment of Resistance of cross-section.

Unit IV: Torsion of Circular Shaftsand Principal Stresses and Strains **(06Hours)**

a) Torsion of circular shafts: theory of torsion, assumptions, derivation of torsion formula. Stresses, strains and deformations in determinate and indeterminate shafts of hollow, solid, homogeneous cross-sections subjected to twisting moments. Power transmitted by shafts.

b) Principal stresses and strains: concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude and orientation of principal stresses andmaximum shear stress.

Unit V: Axially and Eccentrically Loaded Columns. **(06 Hours)**

a) Axially loaded columns: concept of critical load and buckling, Euler's formula for buckling load with hinged ends, concept of equivalent length for various end conditions, Rankine's formula, safe load on column and limitations of Euler's formula.

b) Direct and bending stresses for eccentrically loaded short column and other structural components such as retaining walls, dams, chimneys, etc. Effect of lateral force and self-weight. Resultant stress diagrams due to axial loads, uni-axial, and bi-axial bending. Concept of core of section for solid and hollow rectangular and circular sections.

Unit VI: Slope and Deflection of Beams and Trusses **(06Hours)**

a) Slope and deflection of determinate beams by Macaulay's method and Strain energy method, Castigliano's first theorem. Joint displacement of determinate trusses by Unit load method.

Note: Only the concept explanation can be taught through Online teaching mode, however, the problem solving is to be done in offline mode.

Books:

Text books:

1. Mechanics of Structures Vol. I &II by S. B. Junnarkar and Dr. H. J. Shah, Twenty second edition, Charotar Publishing House Pvt Ltd.
2. Strength of Materials by R. Subramanian, Oxford University Press.
3. Strength of Materials by S. S. Ratan, Tata McGraw Hill.

Reference books:

1. Elements of Strength of Materials by Timoshenko and Young, East-West Press Ltd.
2. Strength of Materials by F.L. Singer and Andrew Pytel, Harper and Row Publication.
3. Mechanics of Materials by Beer and Johnston, McGraw Hill Publication.
4. Introduction to Mechanics of Solids by E.P. Popov, Prantice Hall Publication.
5. Mechanics of Materials by Gere & Timoshenko, CBC publisher.
6. Elementary Structural Analysis by Norris, Wilbur and Utku, Tata McGraw Hill Publisher.
7. Intermediate Structural Analysis by R. C. Hibbler, Pearson Education Publishers.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
201003 : Fluid Mechanics
Credits : 03

Teaching Scheme:
Theory : 03 hrs/week
Practical : 02hrs/week

Examination Scheme:
In-semester : 30 Marks
End-Semester : 70 Marks

Prerequisites:
Engineering Physics, Engineering Mathematics and Engineering Mechanics

Course Objectives:
1. To understand conceptually the properties of fluid, fluid statics, fluid kinematics and fluid dynamics, dimensional analysis, boundary layer theory, open channel flow and fluid flow around submerged objects.
2. Apply principles of continuity, mass, momentum and energy as applied to fluid at rest as well as for fluid flow in open channel.
3. To apply fundamental principles of fluid mechanics for the solution of practical Civil Engineering problems.

Course Outcomes:
At the end of the course, the learners will be able to
1. Understand the use of Fluid Properties, concept of Fluid statics, basic equation of Hydrostatics, measurement of fluid pressure, buoyancy & floatation and its application for solving practical problems.
2. Understand the concept of fluid kinematics with reference to Continuity equation and fluid dynamics with reference to Modified Bernoulli's equation and its application to practical problems of fluid flow
3. Understand the concept of Dimensional analysis using Buckingham's π theorem, Similarity & Model Laws and boundary layer theory and apply it for solving practical problems of fluid flow.
4. Understand the concept of laminar and turbulent flow and flow through pipes and its application to determine major and minor losses and analyze pipe network using Hardy Cross method.
5. Understand the concept of open channel flow, uniform flow and depth-Energy relationships in open channel flow and make the use of Chezy's and Manning's formulae for uniform flow computation and design of most economical channel section.
6. Understand the concept of gradually varied flow in open channel and fluid flow around submerged objects, compute GVF profile and calculate drag and lift force on fully submerged body.

Course Contents:
Unit I: **(07 hours)**

a) **Properties of Fluids:** Definition of fluid and fluid mechanics: examples and practical

applications, classification of fluids: Real and Ideal. . physical properties of fluids: mass density, specific weight, specific volume, relative density, viscosity, Newton's law of viscosity Dynamic and kinematic viscosity, compressibility, cohesion, adhesion, surface tension, capillarity, vapour pressure.

b) Fluid Statics: Basic equation of hydrostatics, concept of pressure, pressure head, Pascal's Law, measurement of pressure (absolute, gauge), principle of manometers: Balancing liquid column, dead weight, pressure transducers and their types, total pressure and centre of pressure: on plane horizontal, vertical, inclined and curved surfaces: practical applications, **Buoyancy and Floatation:** Principle of floatation and buoyancy, stability of floating and submerged bodies

(07 Hours)

Unit II:

a) Fluid Kinematics

Eulerian and Lagrangian approach, velocity and acceleration, and theircomponents in Cartesian co-ordinates, Classification of flows, stream line, stream tube, path line, streak line, control volume. Equation of continuity for 3-D flow in Cartesian co-ordinates, components of rotation, velocity potential, stream function and flow net.

b) Fluid Dynamics: Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration to get Bernoulli's equation and its limitations, Modified Bernoulli's equation, concept of HGL and TEL, Application of Bernoulli's equation to measure discharge and velocity of flow: Venturimeter, Orifice meter, Rotameter and Pitot tube.

(07 Hours)

Unit III:

a) Dimensional Analysis and Model Studies

Dimensional homogeneity, dimensional analysis using Buckingham's π theorem method, geometric, kinematic and dynamic similarity, important dimensionless Numbers (Reynolds No., Froude No., Euler No., Mach no. and Weber No) and their significance, Model Laws (Reynold's law and Froude's Law)

b) Boundary layer Theory

Concept, development of boundary layer on flat plate and factors affecting growth, Boundary layer thickness, displacement thickness, momentum and energy thickness, Laminar sub layer, Local and mean drag coefficients, Hydrodynamically smooth and rough boundary, boundary layer separation and methods to control separation

Unit IV **(07Hours)**

a) Laminar & Turbulent Flow through Pipe: Characteristics of laminar flow, laminar flow through a circular pipe: Hagen Poiseuille equation,Characteristics of turbulent flow, instantaneous velocity, temporal mean velocity, scale of turbulence and intensity of turbulence, Prandtl's mixing length theory, velocity distribution equation, variation of friction factor for laminar flow and for turbulent flow, resistance to flow in smooth and rough pipes, friction factor for commercial pipes, Moody's diagram.

b)Flow through pipes: Energy losses in pipe flow, Equation for major loss and minor losses in pipe, flow through pipes in simple and compound pipe, pipes in series, parallel, Dupit's equation, pipe network analysis by Hardy Cross method, Introduction to siphon.

Unit V **(07 Hours)**

a) Introduction to Open channel flow: Classification of channels, channel flows and geometric

elements of channel, Basic governing equations of Channel flow viz. continuity equation, energy equation and momentum equation, One dimensional approach, Velocity distribution in open channel flow.

b) Uniform flow in open channels: Uniform flow formulae: Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient; Important terms pertaining to uniform flow, viz. normal depth, conveyance, section factor, concept of second hydraulic exponent, Uniform flow computations. Most efficient channel sections: rectangular, triangular and trapezoidal. **Depth-Energy Relationships in Open Channel Flow:** Specific energy and Specific force diagram, Depth discharge Diagram, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Important terms pertaining to critical flow viz. section factor, concept of first hydraulic exponent

Unit VI **(07 Hours)**

a) Gradually Varied Flow (GVF) in Open Channel Flow: Theory and Computation

Basic Assumptions of GVF; Dynamic equation of GVF - Alternative forms; Classification of channel bed slopes,Various GVF profiles, Methods of GVF computations: Direct Step method. (mention of other method)

b) Fluid Flow around Submerged Objects:

Practical problems involving fluid flow around submerged objects, Definitions and expressions for drag, lift, drag coefficient, lift coefficient, types of drag. Introduction to Drag on sphere, cylinder, flat plate and Aerofoil, Karman's vortex street, Development of lift, Introduction to Magnus effect, Lift on cylinder and Aerofoil, Polar diagram.

Books:

Text books:

1 Hydraulics and Fluid Mechanics including Hydraulic Machine by Dr P. N. Modi & S. M. Seth Pub: Standard book house, Delhi-6
2. Flow in Open Channels by K Subramanya, Pub: Tata McGraw Hill, New Delhi
3. A Text Book on Fluid Mechanics and Hydraulic Machines by Sukumar Pati Pub: McGraw Hill, New Delhi

Reference books:

1. Engineering Fluid Mechanics by R. J. Garde and A.J Mirajgaonkar, Pub: SCITECH Publications(India)Pvt.Ltd, Chennai
2. Fluid Mechanics and its Applications, Vijay Gupta, Santosh K Gupta, New Age international pvt. Ltd, New Delhi,
3. Fluid Mechanics, Fundamentals and applications by Yunus. A Cengel and John.M Cimbala, Mc Graw Hill International, New Delhi.
4. Fluid Mechanics by Streeter, Wylie and Bedford – Pub: McGraw Hill International, New Delhi.
5. Open Channel Hydraulics by Ven Tee Chow, Pub: Mcgraw- Hill Book Company- Koga.
6. A Text Book of Fluid Mechanics and Hydraulic Machines- by Dr. R K Rajput Pub: S Chand and Co Ltd. New Delhi

Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
207003 Engineering Geology
Credits: 03

Teaching Scheme:
Theory : 03 hrs/week
Practical : 02 hrs/week

Examination Scheme:
In-semester :30 Marks
End-semester : 70 Marks

Prerequisites:

Course Objectives:

1. To get the knowledge of the physical properties of mineral and differentiate between the rocks types, their inherent characteristics with Civil Engineering applications.
2. To learn geomorphic features formed by fluvial, marine processes and their role, Indian stratigraphy and historical geology in civil engineering projects.
3. To comprehend Structural geology applied to civil engineering projects and to get idea about plate tectonics.
4. To acquire and apply knowledge of PGE essential for civil engineering projects.
5. To identify and to enable the Students to examine favorable & unfavorable conditions for the proposed construction of dams, reservoir and tunnels. Precautions and treatments required to improve the site conditions of dams, reservoir and tunnels.
6. To learn the role played by the effect of Ground water, Geological hazards and the requirement and utility of good building stone.

Course Outcomes:

After successful completion of course, students will be able to :

1. Explain about the basic concepts of engineering geology, various rocks, and minerals both in lab and on the fields and their inherent characteristics and their uses in civil engineering constructions.
2. Exploring the importance of mass wasting processes and various tectonic processes that hampers the design of civil engineering projects and its implications on environment and sustainability.
3. Recognize effect of plate tectonics, structural geology and their significance and utility in civil engineering activities.
4. Incorporate the various methods of survey, to evaluate and interpret geological nature of the rocks present at the foundations of the dams, percolation tanks, tunnels and to infer site / alignment/ level free from geological defects.
5. Assess the Importance of geological nature of the site, precautions and treatments to improve the site conditions for dams, reservoirs, and tunnels.
6. Explain geological hazards and importance of ground water and uses of common building stones.

Course Contents:

Unit I: General Geology, Mineralogy and Petrology **(07 Hours)**

a) Introduction to the subject, scope and sub divisions. **General Geology:**The Earth as a planet, Interior & General composition of the Earth, The rock cycle

b) Introduction to mineralogy: Physical Properties of Minerals, Classification of Minerals, silicate and non-silicate minerals, Rock forming minerals.

c) Introduction to petrology and Broad classification of rocks.

Igneous Petrology: Plutonic, Hypabyssal and Volcanic rocks, Structures, Textures and Classification of Igneous rocks. Study of common rock types prescribed in practical work and their engineering applications.

Secondary Petrology: Rock weathering, Sedimentary Structures, lithification and digenesis Process, Genetic classification of secondary rocks and grain size classification and Textures, Study of common rock types prescribed in practical work and their civil engineering applications.

Metamorphic Petrology: Agents, Types of metamorphism, Texture and structures. Study of common rock types prescribed in practical work and their civil engineering applications.

Unit II: Geomorphology and Historical Geology. **(07 Hours)**

a) Geomorphology: Endogenic and Exogenic processes, Geological action by fluvial process i.e. river and Landforms formed it, Aeolian and glacial process, Coastal geomorphology.

b) Historical Geology: General principles of Stratigraphy, Geological time scale w.r.t. Indian geological time scale, Physiographic divisions of India, Archean's&Dharwar formation, Cudappah formations, Vindhyan formations, Gondwana formations, Deccan Trap formations, significance of their structural characters in major civil engineering activities.

Unit III: Structural Geology, Plate Tectonics **(07 Hours)**

a) Introduction to plate tectonics and Mountain building activity.

b) Structural Geology: Out crop, dip and strike, conformable series, unconformity, its types and overlap, faults and their types, folds and their types, inliers and outlier. Civil engineering importance of faults and folds with examples.

c) Structures of rocks: Igneous intrusions and their types, joints and their types, stratification and lamination.

Unit IV: Remote Sensing and G.I.S., Preliminary Geological Studies **(07 Hours.)**

a) Remote sensing (RS): Definition, Stages of Remote sensing, Remote sensing platforms, Active & Passive Remote sensing, Electromagnetic spectrum, visible band, scattering & absorption of EMR in atmosphere and its effect on Satellite Imagery; resolution of satellite images, Elements of remote sensing for Visual interpretation viz.Tone, shape, size, pattern, texture, shadow and Association.

b) Geographical Information System (GIS): Introduction, Definition, tools, applications of remote sensing and geographical information system in Civil Engineering.

c) Preliminary Geological Exploration: reconnaissance survey, Desk Study, surface and subsurface Geological Investigations: Direct methods likeTest& trial pits, pilot trenches, Drilling, Core inspection significance and limitations of it. Indirect methods like Resistivity, seismic survey and its significance and limitations.

Unit V: Role of Engineering Geology in Dams, Reservoirs and Tunneling. **(07 Hours.)**

a) Geology of Dams & Reservoir: Strength, stability and water tightness of foundation rocks, influence of geological conditions on the choice and type of dam, preliminary geological work on dam and reservoir sites, precautions to be taken to counteract unsuitable conditions and their relevant treatments with case studies.

b) Tunneling: Preliminary geological investigations, important geological considerations while choosing alignment, difficulties during tunneling as encountered due to various geological conditions, Role of groundwater and suitability of common rock types for excavation and tunneling and important case studies in Kasara and BorGhat sections of central railway in Maharashtra and in India, particularly in Himalayas etc.

Unit VI: Geological Hazards, Ground Water and Building Stones. **(07 Hours)**

a) Geological Hazards: Volcanism, Earthquakes & Seismic zones of India, Landslides and stability of hill slopes and preventive measures.

b) Groundwater: Types of ground water, water table and depth zones, influence of hydro geological properties of rocks, types of aquifers, artesian wells and its geological conditions, artificial recharge of groundwater. Geological work of groundwater, levels, effects of dams and canals, effect of pumping, cone of depression, circle of influence, fluctuations in water table Methods of conservation of groundwater and its management; introduction of watershed management.

c) Building stones: Requirements of good building stone: strength, durability, ease of dressing, appearance, mineral composition, textures and field structures, suitability of common rocks as building stone.

Books:

Text Books:

1. Text Book of Engineering Geology by R.B. Gupte , 2001, P.V.G. Publications, Pune.
2. A Text Book of Engineering Geology by N. ChennaKesavulu. 2010, McMillan India Ltd.
3. Principles of Engineering Geology by D. Venkat Reddy. 2010, Vikas Publishers.

Reference Books:

1. Geology P. K. Mukerjee, World Press
2. Engineering Geology by F. G. H Blyth and De Frietus, Reed Elsevier India
3. Geology for geotechnical engineers, J. C. Harvey, Cambridge University Press
4. Principals of Engineering Geology,S.K. Garg, VikasPublishe
5. Engineering Geology, Parbin Singh
6. Geology and Engineering, K. V. G. K. Gokhale, D. M. Rao ,Tata McGraw Hill.
7. Structural Geology, M. P. Billings, Pearson India Pvt. Ltd.

Any Other book of prominent publisher that is recommended by Geology faculty.

SEMESTER V

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301001: Hydrology and Water Resource Engineering

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Fluid Mechanics

Course objectives

01 To introduce students to different government organizations and make them aware about precipitation, runoff, runoff hydrographs and streams gauging.

02 To introduce the concept of reservoir planning, capacity of reservoir, economics of reservoir, floods, hydrologic routing and use of Q-GIS software in hydrology.

03 To impart knowledge of irrigation, crop water requirement, canal distribution network, piped distribution network, revenue collection, ground water hydrology, water logging, and drainage and water management.

Course outcomes

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

01 Understand government organizations, apply & analyze precipitation & its abstractions.

02 Understand, apply & analyze runoff, runoff hydrographs and gauging of streams.

03 Understand, apply & analyze floods, hydrologic routing & Q-GIS software in hydrology.

04 Understand, apply & analyze reservoir planning, capacity of reservoir & reservoir economics.

05 Understand water logging & water management, apply & analyze ground water hydrology

06 Understand irrigation, piped distribution network and canal revenue, apply and analyze crop water requirement.

Course Contents

Unit I: Introduction to Hydrology **(06 Hours)**

Introduction: Hydrological cycle, applications of hydrology, brief introduction of government organizations like IMD, CWPRS, MERI, CDO, Hydrology Project Division, NIH, CWC. Precipitation: Types & forms of precipitation, precipitation measurement, rain gauge network, introduction to real time data transmission weather station and climate change. Consistency test, presentation of rainfall data, mass rainfall curves, hyetograph, point rainfall, mean precipitation over an area, arithmetic mean method, Thiessen's polygon, isohyetel method, concepts of depth-area-duration analysis, frequency analysis, frequency of point rainfall, intensity-duration curves, maximum intensity-duration. Abstractions of precipitation:

interception, depression storage, evaporation- elementary concepts, factors affecting, measurement of evaporation, transpiration, evapotranspiration, modified Penman method,- process and measurement, infiltration: introduction, infiltration capacity, infiltrometer, Horton's method and infiltration indices.

(06 Hours)

Unit II: Run Off

Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff, Runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph theory, S-curve hydrograph, uses and limitations of unit hydrograph, synthetic hydrograph (no numerical on synthetic hydrograph). Stream gauging: selection of site, discharge measurement by velocity-area method, introduction to advance techniques/equipment used in gauge discharge measurements such as radar, current meter, ADCP (acoustic doppler current profiler).

(06 Hours)

Unit III: Floods

Floods: Estimation of peak flow, rational formula and other methods, flood frequency analysis, design floods, brief introduction of hydrologic design of culverts and bridges. Hydrologic flood routing: Muskingum method, Q-GIS software application in hydrology (watershed delineation).

(06 Hours)

Unit IV: Reservoir Planning

Introduction, term related to reservoir planning (yield, reservoir planning and operation curves, reservoir storage, reservoir clearance), investigation for reservoir planning, significance of mass curve and demand curves, applications of mass curve and demand curves, fixation of reservoir capacity from annual inflow and outflow, fixation of reservoir capacity using elevation capacity curve and dependable yield, reservoir losses, reservoir sedimentation- Phenomenon, measures to control reservoir sedimentation, density currents Significance of trap efficiency, useful life of reservoir, costs of reservoir, apportionment of total cost, use of facilities method, equal apportionment method, alternative justifiable expenditure method. (no numerical on cost-economics)

Unit V: Ground Water Hydrology **(06 Hours)**

Occurrence and distribution of ground water, specific yield of aquifers, movement of ground water, Darcy's law, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well, tube wells, open wells and their construction. Water logging and Drainage: Causes of water logging, effects of water logging, preventive and curative measures of water logging, land drainage, reclamation of water logged areas, alkaline and saline lands (no derivation of on spacing of drains), Water Management: Distribution, warabandi, rotational water supply system, participatory irrigation management, co-operative water distribution systems

Unit VI: Introduction to Irrigation **(06 Hours)**

Definition, functions, advantages and necessity, methods of irrigation, surface irrigation, subsurface irrigation, micro-irrigation, Water requirements of crops: Soil moisture and crop

water relationship, consumptive use of water, principal Indian crops, crop seasons, crop water requirement: crop planning, agricultural practices, calculations of canal and reservoir capacities – duty, delta, irrigation efficiency, Piped distribution network for irrigation (PDN), Introduction, advantages and disadvantages of PDN over conventional canal distribution network and its application. Assessment of canal revenue: Various methods (area basis or crop rate basis, volumetric basis, seasonal basis, composite rate basis, permanent basis or betterment levy basis).

Text Books

01 Engineering Hydrology, K. Subramanyam, Tata McGraw Hill.
02 Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, Khanna Publishers, New Delhi
03 Irrigation Engineering & Hydraulic Structures, Vol-2, S. K. Garg, Khanna Publishers, New Delhi

Reference Books

01 A Textbook of Hydrology, Dr. P. Jaya Rami Reddy, USP Publisher.
02 Irrigation, Water Resources and Water Power Engineering, P. N. Modi, Standard Book House.
03 Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, Standard Publisher
04 Irrigation Engineering, Bharat Singh, Nem Chand & Bros., India
05 Irrigation Engineering, H. M. Raghunath, Wiley
06 Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke-Locate Press

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301002: Water Supply Engineering

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Surveying, Building Planning and Fluid Mechanics

Course objectives
01 To make students understand importance of water infrastructure with respect to needs of various users.
02 To discuss and demonstrate the principles of water treatment plant and layout.
03 To inculcate and impart design principles and working of WTP components
04 To interpret need of contemporary issues in water treatment.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Define identify, describe reliability of water sources, estimate water requirement for various sectors
02 Ascertain and interpret water treatment method required to be adopted with respect to source and raw water characteristics
03 Design various components of water treatment plant and distribution system.
04 Understand and compare contemporary issues and advanced treatment operations and process available in the market, including packaged water treatment plants.
05 Design elevated service reservoir capacity and understand the rainwater harvesting.
06 Understand the requirement of water treatment plant for infrastructure and Government scheme.

Course Contents

Unit I: Basics of Water Supply Engineering **(06 Hours)**
Introduction to water supply scheme: importance of water infra structure and introduction to water infrastructure in India, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes like domestic, industrial, institutional, commercial, fire demand and water system losses, factors affecting rate of demand, population forecasting, including numerical. Quality: physical, chemical, radioactivity and bacteriological characteristics, heavy metals. Standards as per IS 10500-2012.

Unit II: Principles of Water Treatment **(06 Hours)**
Water treatment: principles of water treatment operations and processes, water treatment flow sheets with respect to various sources, criteria for site selection for WTP. Aeration: principle

and concept, necessity, methods, removal of taste and odour, design of acration fountain. Sedimentation: plain and chemical assisted, principle, efficiency of an ideal settling basin, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank, introduction and design of tube settlers.

Unit III: Design of Water Treatment Plant **(06 Hours)**

Coagulation and flocculation: necessity of coagulation, principle of coagulation, common coagulants alum and ferric salts, introduction to other coagulant aids like bentonite clay, lime stone, silicates and polyelectrolytes etc, introduction to natural coagulants, concept of mean velocity gradient and power consumption, design of flocculation chamber, design of clari-flocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types: rapid, gravity, pressure filter, multimedia and dual media filters, components, under-drainage system, working and cleaning of filters, operational troubles, design of rapid sand gravity filters.

Unit IV: Introduction to Advanced Water Treatment Methods **(06 Hours)**

Disinfection: mechanism, factors affecting disinfection, types of disinfectants, types and methods of chlorination, break point chlorination, bleaching powder estimation. Water softening methods and demineralization: lime-soda, ion-exchange, R. O. and electrodialysis, fluoridation and defluoridation, introduction to advanced water treatment systems (nano technology), introduction to desalination and various methods of desalination

Unit V: Water Distribution System, Rain Water Harvesting and GIS **(06 Hours)**

Water distribution system: system of water supply: continuous and intermittent system, different distribution systems and their components, ESR: design of ESR capacity, wastage and leakage of water: detection and prevention. Rainwater harvesting: introduction, need, methods and components of domestic rainwater harvesting system. Design of roof top rainwater harvesting system, use of GIS and drone technology in water management: source, treatment and distribution

Unit VI: Water Treatment Plant for Infrastructure **(06 Hours)**

Introduction to Packaged WTP in townships, large commercial buildings, educational institutes, necessity (on-site water treatment), WTP for swimming pools, Building plumbing: introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, pressure reducing valves, break pressure tanks, storage tanks, building drainage for high rise buildings, various kinds of fixtures and fittings used for water saving such as water saving aerators, Government of India initiatives such as SMART city mission and AMRUT mission for improvement of infrastructure sector, service level benchmarks in urban infrastructure and introduction to Jal Jeevan Mission and its implication in rural India.

Text Books

01 Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi.

02 Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi.

03 Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd.

Reference Books

01 Environmental Engineering, Peavy and Rowe, McGraw Hill Publications.
02 Optimal Design of Water Distribution Networks, P. R. Bhave, Narosa Publishing House.
03 Rain Water Harvesting: Making Water Every Body's business,vCentre for Science and Environment.
04 Environmental Remote Sensing from Regional to Global Scales, Ed. Giles Foody, Wiley
05 Water Supply Engineering, Harold Eaton Babbit & James Joseph Doland, Tata McGraw Hill.
06 Environmental Engineering Laboratory Manual, B. Kotain and Dr. N. Kumarswamy, NEERI, Nagpur.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301003: Design of Steel Structures

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis

Course objectives

01 This course is designed to provide understanding of IS code provisions, fundamentals of structural steel design and its applications for design of various components.
02 Students should be able to understand components of steel structures and its arrangements
03 Student should be able to design beams, columns, column footings, roof trusses, gantry girder and plate girders

Course outcomes

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

01 Demonstrate knowledge about the types of steel structures, steel code provisions and design of the adequate steel section subjected to tensile force.
02 Determine the adequate steel section subjected to compression load and design of built up columns along with lacing and battening.
03 Design eccentrically loaded column for section strength and column bases for axial load and uniaxial bending.
04 Design of laterally restrained and unrestrained beam with and without flange plate using rolled steel section.
05 Analyze the industrial truss for dead, live and wind load and design of gantry girder for moving load.
06 Understand the role of components of welded plate girder and design cross section for welded plate girder including stiffeners and its connections.

Course Contents

Unit I: Design Philosophy and Tension Members **(06 Hours)**

Types of steel structures, the chemical composition of structural steel, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP:38, IS: 4000-1992, IS 816–1969, maintenance of steel structure and its methods. Philosophy of limit state design for strength and serviceability, the partial safety factor for load and resistance, various design load combinations. Tension member: various cross sections such as solid threaded rod, cable and

angle sections limit strength due to yielding, rupture and block shear, design of tension member using single and double angle sections and design of connection.

Unit II: Design of Compression Members and Columns **(06 Hours)**

Buckling classification, buckling curves, classification of cross, effective length for compression members and columns, design compressive stress, design of compression member of trusses using single and double angle section and design of connections. Design of axially loaded column using rolled steel section, design of built-up column, lacing and battening and its connections.

Unit III: Eccentric Loaded Columns and Column Bases **(06 Hours)**

Design of eccentrically loaded column providing uniaxial and biaxial bending for section strength, Design of column bases: slab base, gusseted base and moment resistant base for axial load and uni-axial bending

Unit IV: Design of Flexural Members **(06 Hours)**

Design bending strength, laterally restrained and unrestrained beams, design of laterally restrained beams using single rolled steel section with and without flange plate, curtailment of flange plates, low and high shear, check for web buckling, web crippling and deflection. Design of laterally unrestrained beams using single rolled steel section, check for and deflection

Unit V: Design of Industrial truss and Gantry Girder **(06 hours)**

Roof truss: assessment of dead load, live load and wind load, design of purlin, design of members of a truss, detailing of typical joints and supports. Design of gantry girder: selection and design of cross section, check for moment capacity, buckling resistance, bi-axial bending, serviceability and fatigue strength.

Unit VI: Design of Welded Plate Girder **(06 hours)**

Concept of plate girder, components of welded plate girder, intermittent weld, design of cross section, curtailment of flange plates, end bearing, load bearing, and intermediate stiffeners, design of connection between flange & web plate and web plate & stiffeners, check for shear buckling of web, shear capacity of end panel and serviceability condition.

Text Books

01 Limit State Design of Steel Structures, S K Duggal, Tata McGraw Hill Education, New Delhi

02 Design of Steel Structure by Limit State Method as per IS: 800- 2007, Bhavikatti S S, I. K. International publishing house, New Delhi

03 Design of Steel Structures, K. S. Sai Ram, Pearson, New Delhi

Reference Books

01 Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi

02 Limit State Design in Structural Steel, M. R. Shiyekar, PHI, Delhi

03 Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.

04 Limit State Design of Steel Structure, Ramchandra & Gehlot, Scientific Publishers, Pune
05 Analysis and Design: Practice of Steel Structures, Karuna Ghosh, PHI Learning Pvt. Ltd. Delhi
06 Structural Design in Steel, Sarwar Alam Raz, New Age International Publisher
07 Limit State Design of Steel Structure, V L Shah & Gore, Structures Publication, Pune

IS Codes

01 IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi
02 IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
03 IS 875- Part 1 and 2 (1987) and Part 3 (2015): Code of practice for design loads (other than earthquake) for building and structures, Bureau of Indian Standards, New Delhi
04 IS 4000-1992: Code of practice for high strength bolts in steel structures, Bureau of Indian Standards, New Delhi
05 IS 816-1969: Code of practice for use of metal arc welding for general construction in mild steel, Bureau of Indian Standards, New Delhi
06 SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi
07 SP-38: Handbook for typified design for structures with steel roof trusses, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301004: Engineering Economics and Financial Management

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamental knowledge of Economics and Accounting

Course objectives
01 To apply the knowledge of accounting and financial management in civil engineering projects.
02 To prepare, appraise, evaluate, and approve financial plans and interpret financial data.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand basics of construction economics.
02 Develop an understanding of financial management in civil engineering projects.
03 Prepare and analyze the contract account.
04 Decide on right source of fund for construction projects.
05 Understand working capital and its estimation for civil engineering projects.
06 Illustrate the importance of tax planning & understand role of financial regulatory bodies

Course Contents

Unit I: Construction Economics **(06 Hours)**
Economics: definition, principles, importance in construction industry, assets, liabilities, balance sheet, numerical on preparation balance sheet, profit & loss account, difference between microeconomics and macroeconomics, basic economic problems along with case studies. Construction economics: structure of construction industry, economics of road and buildings, irrigation and power, ports and aviation.

Unit II: Introduction to Financial Management **(06 Hours)**
Long- and short-term sources of finance, equity, debt government grants & alternative sources, numerical on calculation of leverage ratio, EBIT & dividend pay-out, financial market & instruments: money, market, secondary market, credit, bill & income security market; goal of financial management, key activities in financial management, role of financing institutes in construction sector: banking institutions, NBFc, housing finance institutions & others.

Unit III: Contract Costing **(06 Hours)**
Construction financial management, role of financial manager in construction financial management, meaning and features of contract costing, types of contract and contract costing procedure, Contract account: definition, format/specimen of contract account, treatment of

various items in the contract account, methods of recording and reporting site accounts between project office and head office.

Unit IV: Capital Budgeting **(06 Hours)**

Budget, types of budgets, master budgets, cost estimating and budgeting in civil engineering project, definition of capital budgeting, time value of money, simple and compound interest, numerical on computation of interest, rule of 72, process of capital budgeting, techniques of capital budgeting, economic decision making in construction project, depreciation, different methods to calculate depreciation and numerical on it, impact of depreciation in economic decision making.

Unit V: Working Capital **(06 Hours)**

Meaning, types of working capital, components of working capital, operating cycle, factors affecting working capital requirement, working capital management, estimation of working capital, components of working capital in Construction Company, inventory management techniques and financing resources of working capital

Unit VI: Taxation and Financial Regulatory Bodies **(06 Hours)**

Introduction to direct and indirect tax, GST, impact of GST on construction industry, tax exemption for contractors, property tax: types, methods of calculation & numerical on computation of property tax, tax deductions against income from property, corporate tax planning, financial regulatory bodies: role & functions, ICRA (Information and Credit Rating Agency of India), SEBI (Security and Exchange Board of India), IRDA (Insurance Regulatory & Development Authority) and RBI (Reserve Bank of India)

Text Books

01 Engineering Economics Management, Dr. Vilas Kulkarni and Hardik Bavishi, S. Chand Publication
02 Laws for Engineers, Vandana Bhatt and Pinky Vyas, Pro Care Publisher
03 Indian Economy, Gaurav Datt and Ashwani Mahajan, S. Chand Publication
04 Industrial Organization & Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publisher

Reference Books

01 Engineering Economy, Theusen G. J. and Fabrycky W. J., 9th Edition, Prentice-Hall, Inc., New Delhi
02 Finance for Engineers: Evaluation and Funding of Capital Projects, Crundwell F. K., Springer, London.
03 Construction Project Management: Theory and practice, Jha K.N., 2nd Edition, Pearson India Education Services Pvt. Ltd.
04 Financial Management, Khan and Jain, Tata McGraw-Hill Education
05 Construction Management and Accounts, Singh H, Tata McGraw Hill, New Delhi.
06 Engineering Economy, Leland T. Blank and. Anthony Tarquin, McGraw Hill
07 Case studies in Finance, Burner, McGraw Hill

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 c: Elective I: Construction Management

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 marks End semester exam: 70 marks

Prerequisite
Fundamental of Project Management

Course Objectives
01 To understand various construction activities and evaluating construction projects.
02 To handle all situations with knowledge of various labour laws and financial aspects of construction projects.
03 To know about risk management and value engineering
04 To utilize material and human resources efficiently with managerial skills interpersonal and intrapersonal skills.
05 To apply knowledge of artificial intelligence on construction project

Course Outcomes
On successful completion of this course, the learner will be able to:
01 Understand the overview of construction sector.
02 Illustrate construction scheduling, work study and work measurement.
03 Acquaint various labor laws and financial aspects of construction projects.
04 Explain elements of risk management and value engineering.
05 State material and human resource management techniques in construction.
06 Understand basics of artificial intelligence techniques in civil engineering.

Course Contents

Unit I: Overview of Construction Sector **(06 Hours)**
Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management: necessity, applications, project management consultants: role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities.

Unit II: Construction Scheduling, Work Study and BIM **(06 Hours)**
Construction project scheduling: definition, objectives factors affecting scheduling, work breakdown structure, project work break down levels, line of balance technique, project monitoring controlling, and introduction to building information modeling (BIM) based on software. Work study (time and motion study): definition, objectives, process of method study, symbols, multiple activity charts, two handed process chart, string diagram.

Unit III: Labour Laws and Financial Aspects of Construction Project **(06 Hours)**

Need and importance of labour laws, study of some important labour laws associated with construction sector, workman's compensation act 1923, building and other construction workers act 1996, child labour act, interstate migrant workers act, the minimum wages act 1948. Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit IV: Risk Management and Value Engineering: **(06 Hours)**

Risk Management: introduction, principles, steps in risk management, risk in construction, origin, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis (examples), decision tree analysis, risk identification, mitigation of project risks, role of insurance in risk management and case study on risk management. Value Engineering: meaning of value, types of value, value analysis, value engineering and its application, energy cost escalation and its impact on infrastructure project.

Unit V: Material Management **(06 Hours)**

Material: introduction, need, objectives and functions and scope of material management, integrated concept of material management, material management organization, various phases of material flow system, application of each phase, role of material manager, role of material management in construction management and its linkage with other functional areas, inventory control methods, EOQ Model, stores management and control, break even analysis, concept of logistics and supply chain management, role of ERP in material management and material resource information systems.

Unit VI: Human Resource Management **(06 Hours)**

Human resource: introduction, nature and scope of human resource management, human resource in construction sector, staffing policy and patterns, human resource management process, human resource development process, recruitment & selection, performance evaluation and appraisal, training & development, succession planning, compensation and benefits, career planning, human resources information systems, HR data and analytics, role of ERP in human resource management and human resource information system. Introduction to artificial intelligence technique, basic terminologies and applications in civil engineering: artificial neural network, fuzzy logic and genetic algorithm.

Text Books

01 Construction Management and Planning, B. Sengupta and H. Guha, Tata McGraw Hill Publications.

02 Total Project Management - The Indian Context, P. K. Joy, Mac Millian Publications.

03 Projects: Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata Mc Graw Hill Publications.

Reference Books

01 Civil Engineering Project Management, C. Alan Twort and J. Gordon Rees, Elsevier Publications

02 Principles of Construction Management, Roy Pilcher (Mc Graw Hill)

03 Human Resource Management, Biswajeet Pattanayak, Prentice Hall Publishers.

04 Materials Management, Gopalkrishnan & Sunderasan, Prentice Hall Publications.

05 Labour and Industrial Laws, S. N. Mishra, Central Law Publications.

06 Artificial Neural Network, Veganarayanan, Prentice Hall.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 d: Elective I: Advanced Concrete Technology

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Concrete Technology

Course objectives
01 To provide an advanced understanding on cement chemistry, influence of supplementary cementitious materials, and effect of admixtures on properties of concrete
02 To illustrate the role of fibers and understand the durability properties of concrete
03 To study advanced testing methods on concrete

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand the chemistry of cement and its effect on properties of concrete
02 Apply the knowledge of supplementary cementitious materials to produce sustainable concretes
03 Understand the mechanism of working of admixtures and their effect on properties of concrete
04 Evaluate the characteristic properties of fiber reinforced concrete
05 Understand the durability properties of concrete
06 Interpret the properties of concrete through advance testing methods

Course Contents

Unit I: Cement and Concrete **(06 Hours)**
Types of cements, Bogue's compounds, structure of a hydrated cement paste, volume of hydrated product, porosity of cement paste, interfacial transition zone in concrete (ITZ), influence of ITZ on properties of concrete, types of elastic moduli, factors affecting elastic modulus of concrete.

Unit II: Supplementary Cementitious Materials **(06 Hours)**
Fly ash, blast furnace slag, silica fume, rice husk ash, metakaolin, industrial waste or by-products, chemical composition and classification, effect on hydration process of portland cement, effect on workability of concrete, effect on the properties of hardened concrete, effect on durability of concrete.

Unit III: Chemical Admixtures **(06 Hours)**
Classification of admixtures, chemistry and mechanism, effect of admixtures on plastic properties and hardened properties of concrete, applications, specialty admixtures - viscosity modifying admixtures, corrosion-inhibiting admixtures, shrinkage-reducing admixtures.

Unit IV: Fiber Reinforced Concrete **(06 Hours)**

Types of fibers, matrix, stress transfer mechanism, steel fiber reinforced concrete (SFRC) – types of steel fibers, balling effect, effect on properties of hardened concrete, applications, slurry infiltrated fiber concrete (SIFCON) - fresh and hardened properties of SIFCON, applications, synthetic fiber reinforced concrete – types of synthetic fibers, properties of fibers, effect of fibers on properties of concrete, applications.

Unit V: Durability of Concrete **(06 Hours)**

Plastic shrinkage, autogenous shrinkage, drying shrinkage, mitigation strategies, transport properties of concrete, permeability, corrosion, chloride penetration, carbonation, sulphate attack and acid attack

Unit VI: Testing of Concrete **(06 Hours)**

Ultrasonic pulse velocity method: theory of pulse propagation through concrete, interpretation of results, corrosion: half-cell potential measurement, electrical resistivity method, permeability and absorption tests, concrete cores – core location and size, drilling, testing and interpretation of results, in-situ load testing.

Text Books

01 Concrete Technology, A.R. Santhakumar, Oxford University Press

02 Concrete Technology, Job Thomas, Cengage Publications

Reference Books

01 Properties of Concrete, A. M. Neville, Pearson Education

02 Concrete: Microstructure, Properties, and Materials, P. Kumar Mehta and Paulo J.M. Monteiro, McGraw Hill Education

IS Codes

01 IS 1199 – 1959, Methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi

02 IS 3085 – 1965, Method of test for permeability of cement mortar and concrete, Bureau of Indian Standards, New Delhi

03 IS 14959 – 2001, Method of test determination of water soluble and acid soluble chlorides in mortar and concrete Part 2: Hardened mortar and concrete, Bureau of Indian Standards, New Delhi

04 IS 516 – 1959, Method of tests for strength of concrete, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301006: Seminar

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	01	Term Work: 50 Marks

Pre-requisites
Fundamentals of Civil Engineering

Course objectives
01 Identify technical / practical problems in the field of civil engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Appraise the current civil engineering research / techniques / developments / interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The seminar report should contain the following. Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks.

01 Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
02 Literature review from books, journals, conference proceedings, published reports / articles / documents. The literature review should be from published literature in the last five years.
03 Theoretical contents related to the chosen topic and case studies if applicable.
04 Concluding remarks or summary.
05 References

Examination: The students must prepare presentation on seminar topic and present in presence of pair of examiners through a viva-voce examination.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301007: Hydrology and Water Resource Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 25 Marks

Term Work

Term work consists of a journal containing details of assignments and visit report. Term work marks will be based on continuous assessment.

01 Analysis of rainfall data (double mass curve technique/missing rainfall data).
02 Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods.
03 Video demonstration of suiatable software used in water resources department.
04 Frequency analysis (return period, hydrologic event)
05 Determination of peak flood discharge in a basin using unit hydrograph technique.
06 Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
07 Application of open-source GIS software for delineation of catchment/watershed.
08 Measurement of / video demonstration of evaporation by pan evaporimeter
09 Measurement of / video demonstration of infiltration by infiltrometer
10 Site visit to meteorological station

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301008: Water Supply Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Practical: 50 Marks

Term Work

Term work consists of a journal containing the following experiments, assignments, and site visit report. Note: Sr. No. 01 to 06, 09 and 10 are compulsory and any one from Sr. No. 07 and 08 practical. The practical examination will be based on the term work.

01 Determination of pH of various samples such as drinking water, prepared acidic and alkaline samples, other samples such as soft drink / tea etc
02 Determination of Alkalinity of raw water and other samples such as prepared sample, soft drinks and tea etc.
03 Total hardness and its components in raw water.
04 Determination of chlorides in water
05 Determination of chlorine demand and residual chlorine.
06 Determination of turbidity and optimum dose of alum.
07 Determination of sodium or potassium or calcium using flame photometer.
08 Determination of fluorides or iron contents in water
09 Determination of Most Probable Number (MPN)
10 Exercise on design of water distribution network using any suitable software such as EPANET / tools (total pipe length @ 10 km and minimum 10-12 nodes)
11 Site visit to a water treatment plant

Any two assignment

12 Study of water intake structures.
13 Complete design of WTP using appropriate software/Program/excel spread sheet etc.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301009: Design of Steel Structures Lab

Teaching scheme	Credit	Examination scheme
Practical: 04 Hours/week	02	Oral: 50 Marks

Term Work

Term work consists of a journal containing the following design, drawing and site visit report. Oral examination will be based on term work.

01 Four full imperial size hand drawn drawing sheets consists of steel structural detailing of 16 sketches based on the syllabus

02 Design of industrial building including roof truss, purlin, bracings, gantry girder, column, column base and connections. Analysis of truss by using suitable software and cross check manually. Use of spreadsheet may be for design of gantry girder. Three full imperial size hand drawn drawing sheets present the design details.

03 Design of welded plate girder: design of cross section, curtailment of flange plates, stiffeners and connections. One full imperial size drawing sheet used to present the design details using any suitable software.

OR

Design of building including primary and secondary beams, column, column base and connections. Analysis of building by using any suitable software and design manual. One full imperial size drawing sheet used to present the design details using any suitable software.

04 Compulsory two site visits based on industrial steel structure and welded plate girder Report should contain structural details with sketches

Note: For term work, the group size should not be more than five students and each group should have different design data.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 e: Elective I: Construction Management Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of journal containing the following. Term work marks will be based on continuous assessment.

01 Site visit to a construction project to study following documents and preparing a report-
   a. Project cash flow analysis.
   b. Use of ERP software
   c. Work break down structure.
   d. Materials flow system in the project.
02 Scheduling of a construction project using line of balance technique.
03 Assignment on work study on any two construction trades.
04 Prepare project balance sheet, profit and loss account statement for any construction project
05 A case study report on risk management
06 Assignment on EOQ model and its variation.
07 Assignment on application of AI techniques in civil engineering.
08 Seminar on any one topic from above syllabus.
09 Any two-assignment based on software (ERP, SAP, HIT OFFICE or equivalent software)

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 d: Elective I: Advanced Concrete Technology Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of following experiments. Term work marks will be based on continuous assessment.

01 Shrinkage test on cement / concrete: Determine the drying shrinkage of cement/concrete in accordance to IS 1199
02 Permeability test on concrete: Determine the permeability of concrete in accordance to IS 3085
03 Flexure test on fiber reinforced concrete beams: Determine the improvement in toughness of concrete containing fibers (any type of fiber)
04 Optimum dosage of admixture using Marsh cone apparatus: Determine the optimum dosage of plasticizers and superplasticizers for different types of cement
05 Test on chloride penetration in concrete: Determine the chloride content in hardened mortar / concrete in accordance to IS: 14959 (Part 2)
06 Elastic modulus of concrete: Determine the elastic modulus of concrete in accordance to IS: 516
07 NDT on concrete: Perform NDT on concrete using ultrasonic pulse velocity method

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301011 b: Audit Course I: Sustainable Energy Systems

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Course objectives

01 To understand the impact of engineering solutions on a global, economic, environmentaland societal context.

02 To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.

Course outcomes

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

01 To demonstrate an overview of the main sources of renewable energy.

02 To understand benefits of renewable and sustainable energy systems.

Course Contents

Unit I: Introduction and Energy Fundamentals

Sustainable energy systems: issues for the 21st century, the critical challenges for a sustainable energy future, sustainable energy system: definitions, indicators, physics of energy: laws of thermodynamics energy forms and conversion, first and second laws and efficiencies devices: heat engines, refrigerators and heat pumps instantaneous and average power.

Unit II: Introduction to Renewable Energy

Wind energy, wind turbine technologies, wind resources and modeling, energy performance and environmental impacts, economics and economic development impacts, photovoltaic: PV and BIPV technologies, solar resources and modeling, energy performance and environmental impacts, economics and net metering.

Unit III: Biomass Electricity

Biomass technologies, introduction biomass productivity and modeling bio power: MSW, willows/switch grass/poplar, wood waste, bio-mass: transport fuels bio fuels, bio ethanol, biodiesel, algal, jatropha bio fuels and water land use impacts, food Vs fuel, renewable fuels standards.

Unit IV: Building Energy

Technologies and policy, smart buildings, lighting and LEDs, Heating/cooling, technologies

Reference books

01 Sustainable Energy Systems and Applications, İbrahim Dinçer, Calin Zamfirescu, Springer

02 Fundamentals of Renewable Energy Systems, D. Mukherjee, Atlantic

03 An introduction to global warming, John R. Barker and Marc H. Ross Am. J. Phys.

Guidelines for Conduction (Any one or more of following but not limited to)
1. Guest Lectures.
2. Visits to sites
3. Studying reports of case studies

Guidelines for Assessment (Any one of following but not limited to)
1. Written Test
2. Practical Test
3. Presentation
4. Report

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301011 a: Audit Course I: Professional Ethics and Etiquettes

Teaching scheme	Credit	Examination scheme
Tutorial: 01 Hours/week	--	Grade

Professional ethics is the underlying concept behind the successful accomplishment of any act of a professional towards achieving the individual and societal goals. These goals should ultimately result in morally, legally, ethically and even culturally acceptable good things for all. Engineers being special group of professionals need to be more conscious of their acts since their duties, rights and responsibilities permeate into the society and the surroundings. To practice professional ethics, understanding of values and concepts are essential.

Course objectives

01 To create awareness on professional ethics and human values.
02 To provide basic familiarity about Engineers as responsible experimenters, research ethics, codes of ethics, industrial standards.
03 To inculcate knowledge and exposure on safety and risk.
04 To expose students to right attitudinal and behavioral aspects.

Course outcomes

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

01 Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories
02 Understand various social issues, industrial standards, code o ethics and role of professional ethics in engineering field.
03 Follow ethics as an engineering professional and adopt good standards and norms of engineering practice.
04 Apply ethical principles to resolve situations that arise in their professional lives

Course Contents

Unit I: Human Values and Engineering Ethics

Morals, values and ethics, integrity, work ethic, civic virtue, valuing time, cooperation, commitment, empathy, self-confidence, stress management, senses of engineering ethics, Kohlberg's theory, Gilligan's theory, models of professional roles, uses of ethical theories.

Unit II: Research Ethics and Codes of Ethics

Industrial standardization, ethical code and its importance, ethical accountability, law in engineering and engineering as social experimentation.

Unit III: Safety, Responsibilities and Rights

Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk collegiality, collective bargaining, confidentiality, conflicts of interest, professional rights, employee rights, intellectual property rights(IPR), discrimination and utilitarianism.

Unit IV: Professional Etiquette

Etiquette at meetings, public relations office (PRO)s etiquettes, technology etiquette phone etiquette, email etiquette, social media etiquette, video conferencing etiquette, interview

etiquette, dressing etiquettes : for interview, offices and social functions, ethical values: importance of work ethics.

Reference books

01 Ethics in Engineering Practice and Research, Caroline Whitbeck, Cambridge Press
02 Intellectual Property Rights, Prabhuddha Ganguli, Tata Mc-Graw –Hill, New Delhi.
03 Professional Ethics and Etiquette (Mastering Career Skills), Checkmark
04 Professional Ethics And Human Values, A Alavudeen, Firewall

SEMESTER VI

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301012: Waste Water Engineering

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Basic Concepts of Engineering Sciences and Mathematics

Course objectives

01 To introduce students about the need of sanitation infrastructure, wastewater treatment, sludge management system and to identify potential of wastewater for recycle and reuse

02 To inculcate an ability to learn the working principle, operation and design of various units of wastewater treatment plant

Course outcomes

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

01 Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams

02 Design preliminary and primary unit operations in waste water treatment plant

03 Understand theory and mechanism of aerobic biological treatment system and to design activated sludge process

04 Understand and design suspended and attached growth wastewater treatment systems

05 Explain and apply concept of contaminant removal by anaerobic, tertiary and emerging wastewater treatment systems

06 Compare various sludge management systems and explain the potential of recycle and reuse of wastewater treatment

Course Contents

Unit I: Sanitation Infrastructure System **(06 Hours)**

Sanitation infrastructure and wastewater quantification: wastewater, sources and types, need for safe sanitation, importance of sanitation infrastructure (centralized, decentralized, onsite and offsite sanitation), wastewater collection and conveyance, quantitative estimation of wastewater, sewage, storm water, self-cleansing velocity and non-scouring velocity in sanitary sewer, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Wastewater characteristics: methods of sampling, conventional and emerging contaminants (physical, chemical and biological) in domestic and industrial wastewater (sugar, dairy, distillery), treatability index, effluent discharge standards as per CPCB norms. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation and terminology (without derivation and numerical), application and limitations.

Unit II: Preliminary and Primary Wastewater Treatment **(06 Hours)**

Treatment: stages, (preliminary, primary, secondary and tertiary treatment), sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber: sources of grit, importance of grit chamber, types, control of velocity, proportional flow weir, parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, importance of removal, methods of oil and grease removal. Equalization and neutralization tanks: introduction, application and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, assumptions, efficiency, factors affecting efficiency, design of primary sedimentation tank.

Unit III: Secondary Treatment: Aerobic Suspended Growth **(06 Hours)**

Aerobic secondary treatment: unit operations and processes for secondary treatment, principle of biological treatment, role of microorganism in wastewater treatment, types of microorganisms, microbial metabolism, microbial growth pattern in batch and continuous system, requirements of microbial growth. Activated sludge process (ASP): Conventional plug flow ASP, biochemical reactions, hydraulic and organic loading, F/M ratio, mean cell residence time, aeration method, oxygen requirement, assumptions, design of ASP, sludge volume index, sludge recycle and rate of return sludge, operational problems and maintenance in ASP, modifications in ASP.

Unit IV: Secondary Treatment: Aerobic Suspended and Attach Growth **(06 Hours)**

Suspended growth system: oxidation pond: bacteria – algae symbiosis, design of oxidation pond, advantages & disadvantages of oxidation ponds. Aerated lagoons: Principle, advantages & disadvantages of aerated lagoons, design of aerated lagoon. Constructed wetlands, phytoremediation and root zone technology: principle, advantages, disadvantages, applications/attached growth system: trickling filter: principle, different TF media & their characteristics, standard rate and high-rate filters, single stage & two stage filters, design using NRC formula, recirculation, ventilation, under drain system, operational problems, control measures. Rotating biological contactors: Principle, advantages, disadvantages, applications

Unit V: Anaerobic Tertiary and Emerging Treatment **(06 Hours)**

Anaerobic treatment: septic tank: suitable conditions and situations, biological principle, method of treatment and disposal of septic tank effluent and design of septic tank. Anaerobic lagoon: principle, advantages & disadvantage, applications. Up-flow anaerobic sludge blanket (UASB) reactor: principle, advantages & disadvantage, applications. Tertiary (advanced) treatment: objectives, introduction to nutrients removal processes, adsorption, ion exchange, membrane processes, advanced oxidation processes, disinfection. Emerging wastewater treatment systems: sequencing batch reactor (SBR), membrane bio reactors (MBR), moving bed bio reactor (MBBR), fluidized membrane bio reactor (FMBR), packed bed reactor (PBR), advantages, limitations and applications

Unit VI: Sludge Management System and Reuse of Water **(06 Hours)**

Sludge management system: primary and secondary sludge, quantity and characteristics,

sludge thickening by gravity thickener, sludge centrifugation, introduction to aerobic digestion, principle of anaerobic digestion, stages of digestion, bio – gas production, characteristics & applications, factors governing anaerobic digestion, design of sludge digestor, sludge dewatering, sludge drying beds, sludge incineration, sludge disposal/ reuse, challenges in sludge management. Wastewater recycle and reuse: driving factors for recycle and reuse, recycling of grey water, municipal sewage, storm water and industrial effluent, reuse opportunities in municipal, industrial, agricultural sector, regulatory guidelines: WHO, US EPA

Text Books

01 Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition

02 Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited

Reference Books

01 Environmental Engineering, Peavy Rowe, McGraw Hill Education (India) Private Limited

02 Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited

03 Industrial Wastewater Treatment, A. D. Patwardhan, Eastern Economy Edition, PHI Learning Private Limited

04 Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication

05 Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association

IS Codes

01 IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301013: Design of Reinforced Concrete Structures

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Fundamentals of Concrete Technology, Engineering Mechanics, Mechanics of Materials and Structural Analysis

Course objectives
01 To provide the students with basic concepts of reinforced concrete structures.
02 To analyze, design and detailing of different component of reinforced concrete structures.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel & concrete.
02 Recognize mode of failure as per LSM and evaluate moment of resistance for singly, doubly rectangular, and flanged sections.
03 Design & detailing of rectangular one way and two-way slab with different boundary conditions
04 Design & detailing of dog legged and open well staircase
05 Design & detailing of singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.
06 Design & detailing of short columns subjected to axial load, uni-axial/bi-axial bending and their footings.

Course Contents

Unit I: Design Philosophies and Analysis **(06 Hours)**
Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.

Unit II: Design of Slab **(06 Hours)**
Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients, design of two way slab: simply supported, continuous and restrained.

Unit III: Design of Staircase and Beams **(06 Hours)**

Design of staircase: dog legged and open well, design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced and flanged), shear, bond and torsion.

Unit IV: Design of Beams **(06 Hours)**

Design of rectangular and flanged cross section continuous beam by using IS code coefficients and moment redistribution method.

Unit V: Design of Column **(06 Hours)**

Assumptions, minimum eccentricity, design of short column for axial load, design of short column subjected to combined axial load and uni-axial/biaxial bending using interaction curves.

Unit VI: Design of Footing **(06 Hours)**

Design of isolated column footing for axial load and uni-axial bending, design of combined footing for two columns: slab type/ slab and beam type rectangular

Text Book

01 Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune

02 Limit State Design of Reinforced Concrete, P. C. Varghese, PHI, New Delhi.

Reference Books

01 Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune.

02 RCC Analysis and Design, Sinha and Roy, S. Chand and Co. New Delhi.

03 Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press.

04 Limit State Analysis and Design, P. Dayaratnram, Wheeler Publishing Company.

05 Comprehensive Design of R.C. Structures, Punmia, Jain and Jain, Standard Book House, New Delhi.

06 Reinforced Concrete Design, S. U. Pillai and D. Menon, Tata McGraw Hill, Delhi.

07 Design of Reinforced Concrete Structures, by M. L. Gambhir, PHI, New Delhi.

IS Codes

01 IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi

02 IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi

03 IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi

04 IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301014: Remote Sensing and Geographic Information System

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
The basic knowledge of Engineering Mathematic, Physics, Surveying, Engineering Geology

Course objectives
01 To comprehend fundamentals and principles of RS and GIS techniques.
02 To enhance students' capacity to interpret images and extract information of earth surface from multi-resolution imagery at multi-scale level.
03 To develop skills of Image processing and GIS
04 To utilize RS and GIS techniques in Engineering Geology and civil engineering.
05 To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
06 To learn buffering and layer analysis for civil engineering applications

Course outcomes
On successful completion of this course, the learner will be able to:
01 Articulate fundamentals and principles of RS techniques.
02 Demonstrate the knowledge of remote sensing and sensor characteristics.
03 Distinguish working of various spaces-based positioning systems.
04 Analyze the RS data and image processing to utilize in civil engineering
05 Explain fundamentals and applications of RS and GIS
06 Acquire skills of data processing and its applications using GIS

Course Contents

Unit 1: Remote Sensing **(06 Hours)**
Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning.

Unit 2: Remote Sensing Satellites and Sensor Characteristics **(06 Hours)**
Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image

interpretation, image interpretation

Unit 3: GPS and GNSS **(06 Hours)**

Introduction to GNSS and Types, IRNSS, GPS, GPS components, differential GPS, types of GPS tracking, application of GNSS in surveying, mapping and navigation

Unit 4: Image Processing and Analysis **(06 Hours)**

Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.

Unit 5: Fundamentals of GIS **(06 Hours)**

Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, thematic layers and layer combinations, difference between drafting software's and GIS, fundamentals of cartography and map design, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.

Unit 6: GIS Data and Applications **(06 Hours)**

GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies: demarcation of dam catchment and command area, application in reservoir sediment analysis, application in land measurement work for land record department, applications of land use and land cover pattern, application in urban planning, applications in irrigation planning and scheduling, application in smart cities planning and development.

Text Books

01 Principals of Remote Sensing, Panda B C, Viva Books Private Limited

02 Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad.

Reference Books

01 Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia

02 Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John Villey

03 Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 a: Elective II: Advanced Engineering Geology with Rock Mechanics

Teaching scheme	Credit	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites

Fundamentals of Engineering Geology, Building Technology, Materials and Civil Engineering Projects like Dams, Tunnels, Reservoirs, Bridges

Course objectives

01 To apply geological principles in various phases of civil engineering projects.
02 To develop ability to carry out independently civil engineering and geological investigations.
03 To choose and compare the site conditions leading to their suitability and to treat geological defects to achieve the economy.
04 To highlight geophysical explorations and their applications in geology.
05 To understand fundamentals of rock mechanics and application part of units.
06 To assess the methods required for geological investigations for tunnels, bridges, and dams.

Course outcomes

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

01 Illustrate seismic zones, plate tectonics and civil engineering significance of major rock formations of India with their characteristics.
02 Explain soil profile, geo-hydrological characters of various rock formations and necessity of geological studies in water conservation.
03 Apply knowledge of geology in Infrastructural, Urban development and demonstrate importance of national wealth.
04 Validate the suitability of rocks based on mechanical properties, R.Q.D. and geophysical exploration.
05 Explore subsurface Geology for civil engineering projects to suggest foundation treatments for various geological defects and channel erosion.
06 Illustrate the suitability of proposed alignments for tunnels and bridges on the basis of Geological investigations.

Course Contents

Unit I: Seismic Zones of India **(06 Hours)**

Geological map of India with special reference to Maharashtra, distribution and geological characters of major rock formations of India, engineering characters of major rock formations of India, the study of plate tectonics and highlights of seismic zones of India.

Unit II: Soil Profile of India **(06 Hours)**

Geological process of soil formations: rock weathering conditions favorable for decomposition, disintegration, effect of climate on formation of soil, soil profile of various states in India, residual and transported soils, various water conservation techniques, effect of over exploitation of tube wells, bore wells and dug wells, artificial recharge, rainwater harvesting, watershed development and necessity of geological studies, relevant case studies highlighting the success and failure of these techniques.

Unit III: Role of Geology in Infrastructural Development **(06 Hours)**

Role of geology in infrastructural and urban development: influence of geological factors upon urban development and planning, reclamation of abandoned grounds and mining regions, geological hazards and mitigation, illustrative examples across the world. Geological importance of National wealth as a construction material: field conditions favorable for occurrences and utility of various rock formations for the purpose of construction material, illustrative examples.

Unit IV: Geophysical Explorations and Rock Mechanics **(06 Hours)**

Geophysical explorations: various methods of geophysical explorations, evaluation and analysis of the data produced during these methods, application of these methods in civil engineering projects. Rock mechanics: general principles of rock mechanics, dependence of physical and mechanical properties of rocks on geological characters, analyzing and evaluating of core recovery, R.Q.D. and joint frequency index, various methods of geo-mechanical classifications of rocks such as Terzahagi, U.S.B.M, R.S.R., Q- system, Deer and Miller, Bieniawaski's geo-mechanical classification (RMR) etc.

Unit V: Geological Subsurface Explorations **(06 Hours)**

Subsurface explorations for dams, reservoir, percolation tanks: evaluation of various geological methods for subsurface explorations, importance of strength and water tightness of rocks occurring and the proposed project site. Case studies illustrating the success and failure of major projects owing to negligence of geological studies, earthquakes occurring in the areas of dams and RIS theory, geological foundation treatments for civil engineering projects: foundation investigation for assessment of geological defects in rocks and suggesting appropriate remedial measures by various treatments. Erosion of tail channels: geological reasons for selection of site for spillway, causes of erosion of channel, relevant case studies.

Unit VI: Engineering Geological Exploration **(06 Hours)**

Geological exploration for tunnels: variations in methodology of investigation for different types of tunnels for different purposes, location, spacing, angles and depths of drill holes suitable for different types of tunnels, difficulties introduced in various geological formation and their unfavorable field characters, stand up time of rock masses and limitations of it. Dependence of protective measures such as guniting, rock bolting, shotcreting, steel fiber shotcreting, permanent steel supports, lagging concreting and grouting above permanent steel supports on geological conditions, illustrative case studies. Bridges: investigation for bridge foundation, special techniques, and objectives of investigation for bridge foundation, bridge foundation based on nature & structure of rock, foundation settlements and case studies.

Text Books

01 Engineering Geology, Subinoy Gangopadhyay, Oxford University Press.
02 Introduction to Rock Mechanics, B. P. Verma, Khanna Pub New Delhi

Reference Books

01 Fundamentals of Rock Mechanics, Jaeger J. C., Cook N. and Zimmerman R, Blackwell Scientific Publications.
02 Introduction to Rock Mechanics, Goodman R. E., John Wiley & Sons.
03 Introduction to Geophysical Prospecting, M. B. Dobbrin, McGraw Hill Inc.
04 Environmental Geology, Keller E A, Prentice Hall Publication.
05 Tunnels: Planning, Design, Construction, T. M. Megaw and J. V. Bartlett, Ellis Horwood ltd. John Willey & Sons.
06 Engineering Geology, Vasudev Kanithi, Universities Press

Handbooks and IS Codes

01 P. W. D. Handbook Chapter - 6, Part-II Engineering Geology, Gupte R. B. Government of Maharashtra.
02 Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi. .
03 Handbook of Geological terms, geology and Physical Geology, David page, University of Michigan.
04 Handbook of Geology in Civil Engineering, Robert Fergussion , Legget, Mc- Graw Hill.
05 Geotechnical Engineering Handbook, Robert day, Mc - Graw Hill.
06 IS 4453-1967: Code of practice for Exploration, pits, trenches, drifts & shaft, Bureau of Indian Standards, New Delhi.
07 IS 6926-1973: Code of practice for diamond drilling for site of investigation river valley project, Bureau of Indian Standards, New Delhi.
08 IS 4078-1967: Code of practice for Logging and Storage of Drilling Core, Bureau of Indian Standards, New Delhi.
09 IS 5313-1969: Guide for core drilling observation, Bureau of Indian Standards, New Delhi.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301016: Internship

Teaching scheme	Credit	Examination scheme
Tutorial: 04 Hours/week	04	Term Work: 100 Marks

Pre-requisites: Fundamentals of Civil Engineering covered in earlier courses

Course objectives

01 To encourage and provide opportunities for students to get professional/personal experience through internships.
02 To learn to apply the technical knowledge gained from academics /classroom learning in real life/industrial situations.
03 To get familiar with various tools and technologies used in industries and their applications.
04 To enable students to develop professional skills and expand their professional network with the development of employer-valued skills like teamwork, communication.
05 To apply the experience gained from industrial internship to the academic course completion project.
06 To nurture professional and societal ethics in students
07 Understand the social, economic and administrative considerations that influence the working environment of industrial organizations

Course outcomes

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

01 To develop professional competence through industry internship
02 To apply academic knowledge in a personal and professional environment
03 To build the professional network and expose students to future employees
04 Apply professional and societal ethics in their day to day life
05 To become a responsible professional having social, economic and administrative considerations
06 To make own career goals and personal aspirations

CO-PO Mapping Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	1	1	1	2	1	1
CO2	1	2	2	2	3	2	1	1	1	2	2	1
CO3	-	-	-	-	-	1	-	-	2	2	1	1
CO4	2	-	-	-	-	2	2	3	-	1	-	2
CO5	-	-	-	-	-	1	2	1	1	1	2	1
CO6	-	-	-	-	-	1	1	-	2	1	-	1

Guidelines of Internship

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

1. Duration: Internship to be completed after semester V and before commencement of semester VI of at least 4 to 6 weeks. It is to be assessed and evaluated in semester VI.

2. Internship work Identification: Student may choose to undergo Internship at Industry/Govt./NGO/MSME/Rural Internship/Innovation/IPR/Entrepreneurship. Student may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/NGO's/Government organizations/Micro/Small/ Medium enterprises to make themselves ready for the industry [1].

Contacting various companies for Internship and Internship work identification process should be initiated in the Vth semester in coordination with training and placement cell/ industry institute cell/internship cell. This will help students to start their internship work on time. Also, it will allow students to work in vacation period after their Vth semester examination.

Student can take internship work in the form of online/onsite work from any of the following but not limited to:

a. Working for consultancy/ research project
b. Participation at events (technical/business) in innovation related completions like Hackathon
c. Contribution in incubation/innovation/entrepreneurship cell/institutional innovation council/startups cells of institute
d. Learning at departmental lab/tinkering lab/institutional workshop
e. Development of new product/business plan/registration of start-up
f. Participation in IPR workshop/leadership talks/ideal design/innovation/business completion/technical expos
g. Industry/government organization internship
h. Internship through Internshala

i. In-house product development, intercollegiate, inter department research internship under research lab/group, micro/small/medium enterprise/online internship
j. Research internship under professors, IISC, IIT's, research organizations
k. NGOs or social internships, rural internship
l. Participate in open source development
m Development of Physical and/or numerical, mathematical, soft computing model
n Carrying out surveys related to society related but Engineering problems. For example, a survey of solid waste management in a particular area/town/village, survey of water supply network in a locality, town, village etc. , survey of air quality etc.

[1] https://www.aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf

3. Internship Diary/ Internship Workbook: Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary the day-to-day account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.

Internship diary/workbook and internship report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the institute immediately after the completion of the training. Internship diary/workbook may be evaluated on the basis of the following criteria.

i. Proper and timely documented entries
ii. Adequacy & quality of information recorded
iii. Data recorded
iv. Thought process and recording techniques used
v. Organization of the information

4. Internship Work Evaluation: Every student is required to prepare and maintain documentary proofs of the activities done by him as internship diary or as workbook. The evaluation of these activities will be done by programme head/cell in-charge/project head/ faculty mentor or Industry Supervisor based on overall compilation of internship activities, sub-activities, level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and evaluation is to be done in consultation with internship supervisor (internal and external) and a supervisor from place of internship.

Recommended evaluation parameters: Post internship internal evaluation 50 Marks and internship diary/workbook and internship report 50 Marks. Evaluation through Seminar Presentation/Viva-Voce at the Institute

The student will present a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria.

Depth of knowledge, communication skills, presentation skills, team work, creativity, planning & organizational skills, adaptability, analytical skills, attitude and behavior at work, societal understanding, ethics, regularity and punctuality, attendance record, log book, student's feedback from external internship supervisor

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact industrial supervisor/faculty mentor/TPO for assigning special topics and problems and should prepare the final report on the student's presence physically, if the student is found absent without prior intimation to the department/institute/concern authority/T & P Cell, entire training can be cancelled.

The report shall be presented covering following recommended fields but not limited to:

- ✓ Title/cover Page
- ✓ Internship completion certificate
- ✓ Internship place details: Company background-organization and activities/scope and object of the study/personal observations
- ✓ Index/table of contents
- ✓ Introduction
- ✓ Title/problem statement/objectives
- ✓ Motivation/scope and rationale of the study
- ✓ Methodological details
- ✓ Results/analysis/inferences and conclusion
- ✓ Suggestions/recommendations for improvement to industry, if any
- ✓ Attendance record
- ✓ Acknowledgement
- ✓ List of reference (books, magazines and other sources)

5. Feedback from internship supervisor (external and internal): Post internship, faculty coordinator should collect feedback about student with following recommended parameters.

Technical knowledge, discipline, punctuality, commitment, willingness to do the work, communication skill, individual work, team work and leadership

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301017: Waste Water Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

The term work consists of a journal having details of at least 8 experiments. Experiment No. 12 and the assignments are compulsory. Oral examination based on term work.

List of experiments

01 Determination of dissolved oxygen in a given water and wastewater sample

02 Determination of Bio-Chemical Oxygen Demand in a given wastewater sample

03 Determination of Chemical Oxygen Demand in a given wastewater sample

04 Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample

05 Determination of Sludge Volume Index in a given wastewater sample

06 Determination of Electrical Conductivity in a given wastewater sample

07 Determination of Phosphates by spectrophotometer in a given wastewater sample

08 Determination of Nitrates by spectrophotometer in a given wastewater sample

09 Determination of heavy metals like Cr6+ or Zn or Ni or Cd in a given wastewater sample

10 Determination of Kjeldahl nitrogen in a given wastewater sample

11 Visit to domestic / Industrial wastewater treatment plant & its detailed report

12 Computer aided design of Sewage Treatment Plant (STP) OR Effluent Treatment Plant (ETP) of Sugar/ Dairy/Distillery Industry using suitable software (e.g., ASIM, STOAT) or excel sheets

Assignment

01 Brief report on sewer materials, choice of materials, testing of sewer pipes, sewer appurtenances.

02 Brief report on a case study of package wastewater treatment plant

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301018: Design of Reinforced Concrete Structures Lab

Teaching scheme	Credit	Examination scheme
Practical: 04 Hours/week	02	Oral: 50 Marks

Term work

Term work consists of a journal containing the following design, drawing and site visit report. Oral examination based on term work.

01 Design Project: Design of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings and staircase (first and intermediate flight) with following details.

i. Minimum plan area of each floor shall be more than 150 m^2
ii. Design of plinth and ground beams: for each type two simply supported and two continuous.
iii. Design of all slabs and beams of typical floor (first or second floor)
iv. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending,
(c) axial load with biaxial bending, from terrace level to footing along with detailed load calculations.
v. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending.
vi. Design any one element by using spread sheet or use of analysis and design by suitable software.
vii. Four full imperial drawing sheets. Out of which only structural plan drawing sheet shall be drawn by using any drafting software. Schedule of slabs, beams, columns and footing can be prepared by using any drafting software.
viii. Detailing of reinforcement should be as per SP-34 & IS-13920.

02 Two assignments on design of combined footing along with reinforcement detailing

03 Reports of two site visits. (Building under construction)

Note: For term work, the group size should not be more than five students and each group should have different design data.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301019: Remote Sensing and Geographic Information System Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work shall consist of seven experiments out of which 1 to 6 are compulsory and any one from 7 to 9. Term work marks will be based on continuous assessment.

01 Study of fundamental tools of software for data processing.
02 Import and export data GIS software to the Auto-CAD or Revit software and mention all the necessary steps used.
03 Geo-reference and Geo-tag using Google earth/ base map.
04 Digitize the given part of toposheet using software & attribute (Name, area, length, as per requirements).
05 Generation of thematic maps (contour, drainage, road etc.) in software.
06 Visual image interpretation from aerial photos and/or satellite images.
07 Preparation of DEM to study geomorphoplogical features and nature of slope.
08 Explore utilization of RS and GIS for development of smart city.
09 Land use classification using RS data.

Note: Use open-source software like QGIS, GRASS etc. for performing the experiments.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 a: Elective II: Advanced Engineering Geology with Rock Mechanics Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

The practical journal consists of following experiments and term work marks will be based on continuous assessment.

01 Study of Geological map and seismic zone map of India
02 Study of some parameters of morphometric analysis of river, toposheet will be made available by the college.
03 Study of Soil Profile of any region in India
04 Use of electrical resistivity method for determining depth of bedrock.
05 Computation of RQD & Joint Frequency Index for interpretation of drill hole data
06 Logging of drill cores, preparation of Litho logs and interpretation of drill data, preparing geological cross sections from drill hole data and using them for designing of civil engineering structures representing following case studies.
   1. Dipping sedimentary formation.
   2. Faulted region.
   3. Folded region.
   4. Locating spillway.
   5. Tunnels in Tectonic areas.
   6. Tunnels and open cuts in non-tectonic areas.
07 A compulsory site tour to study geological aspects of an engineering projects and writing a report based on studies carried out during visits.

Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 003 c Elective III: Integrated Water Resources Planning and Management

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basics of fluid mechanics, geology, geotechnical engineering, hydrology and surveying

Course objectives
01 To introduce connection of agriculture and water with IWRP & M and to make students aware about organizations like WALMI
02 To introduce the connection of IWRP & M with water
03 To impart knowledge of legal aspects

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand concerned organizations, IWRP & M objectives, principles, challenges, application & analysis of IWRP&M approaches & principles in a case study.
02 Understand PIM, WDS, WALMI, agriculture in the concept of integrated water resources, apply and analyse water requirements for food production
03 Understand assessment of surface and ground water quality, EIA, CPCB regulations, application & analysis of effluent quality standards as per CPCB
04 Understand water economics and funding, application & analysis of planning for a sustainable water future
05 Understand legal regulatory settings of IWRP & M, application & analysis of inter-basin water transfers and IWRP & M
06 Understand flood control & power generation for IWRP & M, application QIGIS for analysis of a basin for IWRP & M

Course Contents

Unit I: Introduction to IWRP & M **(06 hours)**
Concept, definitions, objectives, principles, challenges and needs, components, approaches of IWRP & M, water as a global issue, introduction of global water partnership (GWP), introduction of central water commission (CWC), national water policy (only introductory), discussion of one case study

Unit 2: Agriculture & IWRP & M **(06 hours)**
Agriculture in the concept of integrated water resources, water requirement for food production (numerical to be covered), blue Vs green water disputes, global water security -virtual water trading, irrigation methods and efficiencies of these methods (numerical to be covered), current water pricing, ground water quality protection, sea water intrusion into fresh water aquifers due to human activities, ground water recharge (no numerical on ground water), participatory irrigation management (PIM), water distribution society's (WDS), introduction of water and land management institute (WALMI)

Unit 3: Considerations for Water Supply & Health **(06 hours)**

Importance of assessment of river water quality, prevention & control of surface & ground water pollution, cost effective water quality monitoring for basins, environmental impact assessment (EIA), central pollution control board (CPCB) regulations, need of training to water users for sustainability. application of polluters pays principle, need of treatment facilities for domestic sewage and industrial effluents, effluent quality standards as per CPCB and its strict implementation and monitoring, discussion of one case study.

Unit 4: Water Economics and IWRP & M **(06 hours)**

Water as economic good, economic value of water, water scarcity, importance of Water to the Indian economy, principles of planning and financing of water resources project: discussion on any two case studies, sustainability principles for water management, framework for planning a sustainable water future, economics and decision making.

Unit 5: Legal Regulatory Settings & IWRP&M **(06 hours)**

Global and national perspectives of water crisis, UN laws on non-navigable uses of international water courses, current water laws and regulation (national, state & local), water rights & priorities, CWC laws & guidelines, inter-basin water transfers and integrated water resources management, importance of arbitration in IWRM, Dublin Principles (1992), discussion of one case study.

Unit 6: Flood Control & Power Generation **(06 hours)**

Role of dams in flood control and power generation and its importance in IWRM, management of flood plains, flood risk mapping, flood forecasting and disaster relief, coordination between co-basins for flood management, use of QGIS for IWRM, effects of hydraulic structures on river surface profiles and sediment transport, hydro power generation, basic introduction of soft computing techniques for flood forecasting (only introductory).

Text Books

01 Integrated Water Resources Management: Water in South Asia Volume I, Peter P Mollinga, Ajaya Dixit and Kusum Athukorala, Sage Publications.

02 Ecosystem Principles and Sustainable Agriculture, Sithamparanathan, Rangasamy A. and Arunachalam, N, Scitech Publications (India) Pvt. Ltd, Chennai.

Reference Books

01 Water Resources System Planning & Management, M. C. Chaturvedi, Tata McGraw-Hill.

02 Water Resources Systems Engg, D. P. Loucks, Prentice Hall.

03 Economics of Water Recourses Planning, L. D. James & R. R. Lee, McGraw Hills, New York

04 Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs, Peter P Mollinga, SAGE Publication

05 Principles of Water Resources: History, Development, Management and Policy, Thomas V., John Wiley and Sons Inc., New York. 2003.

06 Watershed Management in India, Murthy, J. V. S., Wiley Eastern Ltd., New York, 1995.

07 Soil Conservation and Land Management, Dalte, S.J . C., International Book Distribution,

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 a Elective IV: Air Pollution and Control

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basic concepts of sciences, mathematics

Course objectives
01 Impart the knowledge and understanding of outdoor and indoor air pollution, its impact and existing legislation and regulation.
02 Make aware about the meteorology, measurement techniques, emission inventory and modeling aspects.
03 Provide the scientific and technical background of state of the art air pollution control technologies.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Recall air pollution, legislation and regulations.
02 Evaluate air pollutant concentrations as a function of meteorology.
03 Interpret sampling results with prescribed standards.
04 Assess emission inventory and air quality models.
05 Compare the air pollution control equipments.
06 Infer indoor air pollution and its mitigation.

Course Content

Unit 1: Air Pollution, Legislations and Regulations **(06 hours)**
Air Pollution: Layers of atmosphere, Atmospheric temperature and altitude, Composition of air, Definition of air pollution, Air pollution episodes and accidents (Donora Pennsylvania 1948, Great London Smog 1952, Bhopal Gas Tragedy 1984), Classification of air pollutants (Based on sources, origin and state of matter), Criteria and hazardous air pollutants, Greenhouse gases, Sources of air pollution, Scales (micro, meso, macro), Processes and fates (Advection, convention, Diffusion, dispersion), Impact on human health and its valuation, Ozone depletion, Acid rain, Global warming, Climate change, Estimation of Carbon footprints (Numerical Included). Legislations and regulations: A case study (Air Act 1981, The Air Rules 1982, Central Motor Vehicles Act 1988, Environmental Protection Act 1986, National Environment Tribunal Act 1995, National Green Tribunal Act 2010, Draft Notice for e-Vehicles in National Capital Region 2022), Major Government Initiatives for managing ambient air quality (NAMP-National Air Quality Program, AQI-Air Quality Index (Significance, calculation method adopted by CPCB), NCAP-National Clean Air Program).

Unit 2: Meteorological Aspects **(06 hours)**
Meteorology, Meteorological parameters and measuring instruments, Wind rose diagram, Environmental lapse rate (ELR) and adiabatic lapse rate (ALR), Inversion and its types, Atmospheric stability, Pasquill-Gifford classification, Plume behaviour, Horizontal and vertical dispersion coefficients, mixing height, Determination of mixing height using radio-soundings and remote sounding system, Stack height determination (Numerical included), CPCB recommendations, Plume rise estimation using Brigg's formula (Numerical included), Gaussian dispersion equation for point source; assumptions, advantages and limitations (Numerical included).

Unit 3: Ambient Air Sampling, Analysis and Standards **(06 hours)**

Ambient Air sampling and Analysis: Air pollution survey, basis and statistical considerations of sampling sites, Conversion of $\mu g/m^3$ to ppm, devices and methods used for sampling of particulates and gaseous air pollutants. Use of aerosol spectrometer and sensors, Stack emission monitoring for particulate and gaseous air pollutants, isokinetic sampling, Air Quality and Emission Standards: Components of air quality standards (Indicator, averaging time, form, level), National Ambient Air Quality Standards (NAAQS) 2009 and Emission standards in India, WHO air quality guidelines 2021, Interpretation of sampling results with case study.

Unit 4: Emission Inventory and Air Quality Modeling **(06 hours)**

Emission inventory: Definition, Role in air quality management, Utilization, Development approach (Bottom-up, Top-down), Basic equation of emission estimation, Types (Annual average, seasonal, forecasted and gridded), Emission inventory framework developed by CPCB, Air Quality Modeling: Introduction, Basic components, Importance, classification (Based on time period, pollutant type, coordinate system, level of sophistication), Types of air quality models (Physical, statistical, deterministic), AERMOD model USEPA (Assumptions, strengths and limitations).

Unit 5: Control of Air Pollution **(06 hours)**

Natural self-cleansing properties (Dispersion, gravitational settling, absorption, rainout, adsorption). Objectives, Control by process modification, change of raw materials, fuels, process equipment and process operation, Control of particulates from stationary sources: Removal Mechanism, collection efficiency, control equipment as Settling chamber, inertial separators, cyclone, fabric filter and electro Static precipitator, Scrubbers, Factors affecting selection of device (Numerical included). Control of gaseous pollutants from stationary sources: Absorption, adsorption, incineration/ combustion, carbon sequestration for CO_2, Control of emissions from mobile sources: Emission sources, Control of emissions from each source.

Unit 6: Indoor Air Pollution **(06 hours)**

Causes, sources, health impacts, factors affecting indoor air quality, sick building syndrome, General aspects of exposure assessment, Sampling design, Active and Passive samplers, monitoring of ventilation rates, Mitigating technologies: Source control, Improved ventilation, air cleaning, Types of air cleaners, Air cleaning technologies, Practical considerations using portable and in-duct air cleaners, Use of plants for control, Radon removal technique, Sources and remedial measures for odour control.

Text books

01 Air Pollution: Its origin and control, 3rd Edition, Kenneth Wark, Cecil F. Warner, Wayne T. Davis, Addison-Wesley Longman. 1998.

02 Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010

Reference books

01 Air Pollution, M. N. Rao, H. V. N. Rao, McGraw Hill, 2004.

02 Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015.

03 Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., Academic Press, 2005.

04 Methods of Air Sampling and Analysis, Lodge, J.P. (Ed.), CRC Press, 1988.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 d Elective IV: Airport and Bridge Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Basic of computer, understanding of drawings and specifications

Course Objectives
01 Introduce the aspect of airport and bridge system.
02 Study plans, specifications for planning and design.
03 Involve in the planning and design of new runways and terminal buildings
04 Select and design the bridge that will meet the needs of the area

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand the fundamental of airport.
02 Understand and design the runway and taxiway and drainage systems.
03 Understand the BIM, AR and VR in airport planning and pavement design.
04 Plan the lighting and marking of airport and heliport.
05 Estimate various components of bridge and loads on bridges.
06 Study and design of bridge structures.

Course Content

Unit 1: Introduction and Classification of Airport **(06 hours)**
General, transportation systems, typical air trip, the air age, world civil air transport, geographic distribution of world air transport, air ports characteristics of good layout, runway configuration, airport obstruction, location of terminal buildings, aprons and hangers. zoning requirements regarding permissible heights of constructions and landing within the airport boundary, airport landslide planning, navigation and landing aids – ILS, air traffic control (ATC). Airport classification: community size and airport types, airport classification according to types of services, functional classification of airports, airport classification for the purpose of stipulating geometric standards, ICAO, FAA

Unit 2: Aircraft Characterizes and Geometric design **(06 hours)**
Introduction to Aircraft Characterizes: related to airport design characterizes of principle transport aircrafts, trends size, speed and productivity of transport aircraft, turning radii. airport planning, size and type of airport, selection of site for the airport. Geometric design: element of an airport, runway and taxi way width, runway profile and runway length, runway orientation, corrections and calculation, introduction to analytical methods for air travel demand for planning and casting, case study- airport master plan.

Unit 3: Airport Visualizing, Airport Capacity and Airport Pavements **(06 hours)**
Airports visualizing: introduction to visualizing airports in a virtual environment, building information modelling (BIM) for air ports, introduction to augmented reality (AR) and virtual reality (VR) in airport planning and design, Airport capacity: ultimate and practical runway capacity, runway

arrangement factors effecting runway capacity, practical annual capacity and practical hourly capacity, Airport pavements: comparison- highway and airfield pavement, design of rigid airport pavements, design of rigid pavement and design of flexible pavement, junction of flexible and rigid pavements, airport drainage.

Unit 4: Airport Marking and Lighting- Heliports **(06 hours)**

Airport Marking and lighting: the need for marking and lighting, runway lighting, runway marking , runway designation marking , runway center marking , threshold marking, fixed distance marking , touchdown zone marking , runway side strips marking, Heliports: helicopter characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, heliport marking and lighting, vertical takeoff and landing (VTOL), short takeoff and landing (STOL).

Unit 5: Introduction to Bridges **(06 hours)**

Classification, selection of bridge site and preliminary and detailed survey work, computation of discharge, linear waterway, economic span, afflux, scour depth, effective width, introduction to design loads for bridges, IRC loading standards, load distribution theory, bridge slabs, substructure: abutment, piers, and wing walls with their types based on requirement and suitability.

Unit 6: Types of Bridges **(06 hours)**

Culvert: definition, location, waterway of culvert and types, design of pipe culverts, design of box culvert (Single vent only). Temporary bridges: definition, materials used, brief general ideas about timber, floating- pontoon bridges. (Introduction only), Movable bridges: bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability. (Introduction only), Fixed span bridges: simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, materials for super structure. Bearing: definition, purpose and importance, types of bearings with their suitability (Introduction only).

Text books

01 Airport Engineering, by Saxena S.C., CBS Publishers & Distributors
02 Airport planning and design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee
03 Bridge Engineering by Rangwala, Charotar Publication
04 Aiport Engineering by Rangwala, Charotar Publication

Reference books

01 Ashford, N., and P. H. Wright. 1992. Airport Engineering, 3rd ed. New York: John Wiley & Sons
02 Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi.

Handbooks and Manuals

01 Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902
02 Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000
03 https:///panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridges-direct-download-links-from-panchayatraj-engineers-blog
04 Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 005: Project Stage I

Teaching scheme	Credits	Examination scheme
Practical: 04 Hours/week	01	Term Work: 50 Marks
	02	Oral: 50 Marks

Pre-requisites
Fundamentals of Civil Engineering

Course objectives
01 Identify latest technical/practical problems in the field of Civil Engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The Project Stage I report should contain the following. Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of minimum two and maximum five students.

01 Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
02 Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years.
03 Problem statement and methodology
03 Theoretical contents related to the chosen topic or case studies if applicable.
04 Concluding remarks or summary.
05 References

Oral Examination: The students must prepare presentation on Project Stage I and present in presence of pair of examiners through a viva-voce examination.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 007 c Elective III: Integrated Water Resources Planning and Management Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work will consist of the following. Oral examination based on the term work.

01 Detail report on components and approaches of IWRP & M
02 Detail report on national water policy
03 Detail report on participatory irrigation management and water distribution societies
04 Detail report on effluent quality standards as per CPCB
05 Detail report on economics in IWRP & M and decision making
06 Detail report on Dublin Principles (1992)
07 Detail report on water laws (National, State & Local)
08 Detail report on global water partnership (GWP)
09 Application of soft computing tool for flood forecasting
10 Application of QGIS for IWRM

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 d Elective IV: Airport and Bridge Engineering Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following. Term work marks will be based on continuous assessment.

A. Compulsory assignment

01 Runway design for length and related corrections, and sketches of essential runway markings.
02 Design of pipe culverts and design of box culvert (Single vent only) one each.
03 Structural design of flexible or rigid runway

B. Any six from the following

01 Report on study of recent trends in airport planning and design.
02 Selection of bridge site, alignment and collection of design data.
03 Site visit to bridge site or airport site (report on visit)
04 Seminar on one topic of building information modeling (BIM) system.
05 Report on guest lecture in applications of AR and VR in Airport or bridge engineering.
06 Prepare the drawing/plate (A3)/PPTs on airport marking and lighting (describing importance)
07 Collection of information and preparation of PPTs on Heliports.
08 Prepare report on movable bridges/ temporary bridges/bearing.
09 Power point presentation on bridge substructure.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 009: Computer Programming in Civil Engineering

Teaching scheme
Theory: 01 Hours/week

Practical: 02 Hours/week

Credits
02

Examination scheme
In semester Exam: NA
End semester Exam: NA
Term Work: 50 Marks

Prerequisites
Basic knowledge of computer programming, Civil Engineering

Course Objectives
01 To understand the basics of python programming.
02 To develop Python programs for civil engineering problems

Course Outcomes
At the end of course the learner will be able to,
01 Understand basics of Python Programming
02 Write Python codes for variety of problems in civil Engineering

Course Content

Unit I: Introduction to Python **(06 hours)**
Introduction of programming, introduction of python and its programming cycle, python interpreter and interactive mode, introduction of python integrated development environment (IDE), variables and identifiers, arithmetic operators, values and types, statements, operators, boolean values, operator precedence, expression, conditionals: if - else constructions. Loops: purpose and working of loops, do-while loop, for loop, nested loops, break and continue.

Unit II: Functions and Data Structures in Python **(06 hours)**
Function: parts of a function, execution of a function, keyword and default arguments, scope rules. Strings: length of the string and perform concatenation and repeat operations in it, indexing and slicing of strings, python data structure: tuples, unpacking sequences, lists, mutable sequences, list comprehension, sets. Dictionaries higher order functions: treat functions as first class objects, lambda expressions, introduction to python related libraries like NumPy, Matplotlib, seaborn and applications Keras and Tensor Flow.

Reference Books

01 Learning Python, Romano Fabrizio, Packt Publishing Limited.
02 Head First Python- A Brain Friendly Guide, Paul Barry, SPD O'Reilly, 2nd Edition.
03 Python: The Complete Reference, Martin C. Brown, McGraw Hill Education.

Term Work

Term work consists of any 10 mandatory laboratory assignments from the following. Students should complete these assignments by their developing/writing their own codes. Term work marks will be based on continuous assessment.

01 Application of python for **Open Channel Flow** (Analysis of rrectangular/triangular/trapezoidal channel)

02 Application of python for **Hydrology** (Determine the infiltration capacity and infiltration indices)

03 Application of python for **Groundwater Engineering** (Determine the discharge of a steady flow in a confined aquifer using Dupuit's equation)

04 Application of python for **Transportation Engineering** (Design the plain cement concrete pavement for two lane highway based on given conditions)

05 Application of python for **Infrastructure Engineering** (Estimation of productivity of construction equipment's like earthwork equipment)

06 Application of python for **Concrete Technology** (Estimation of strength of concrete or any mix design problem as per IS :10262-2019)

07 Application of python for **Structural Engineering** (Determine main steel for simply supported one way slab. Effective depth of slab is 125 mm and maximum moment in a slab is 22 kN.m, M25 grade of concrete and Fe 500 grade of steel)

08 Application of python for **Structural Engineering** (Determine the magnitude and nature of forces in members of statically determinate pin jointed truss by method of section)

09 Application of python for **Solid Waste Engineering** (Determine the settling velocity of suspended solids)

10 Application of python for **Environmental Engineering** (To find out the residual chlorine from given water with specifically mentioned doses of chlorine)

11 Application of python for **Soil Mechanics** (Find out the stress distribution in a soil using Boussinesq's equation)

12 Application of python for **Foundation Engineering** (Find out the shear strength of a soil with given data)

13 Application of python for **Quantity Analysis** (Determine the total volume of concrete in the trapezoidal footing)

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 013 a Elective V: Earthquake Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering Mechanics, Engineering Geology, Structural design, Geotechnical Engineering, Engineering Mathematics

Course objectives

01 Introduce the aspect of earthquakes and vibrations.
02 Model real and physical dynamic problems.
03 Solve equations of motions for various oscillatory systems.
04 Perform static and dynamic seismic analysis for buildings.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Define the concepts of earthquakes, seismology and vibrations.
02 Model physical structures and develop equations of motion.
03 Solve the equations of motion for SDOF systems.
04 Solve the equations of motion for MDOF systems.
05 Perform static seismic analysis for buildings.
06 Perform dynamic seismic analysis for buildings.

Course Content

Unit 1: Earthquake and Seismology **(06 hours)**

Causes of earthquakes, seismic waves, magnitude and intensity of earthquakes, seismographs, accelerometers, ground motion parameters, peak acceleration, peak velocity, peak displacement, ground motion spectra

Unit 2: Vibration Analysis: SDOF Systems **(06 hours)**

Types of vibrations, dynamic equilibrium, mathematical modelling, stiffness, damping, types of damping, single degree of freedom (SDOF) systems, and solution to SDOF systems subjected to free and forced vibrations.

Unit 3: Vibration Analysis: MDOF Systems **(06 hours)**

Modeling of multi degree of freedom (MDOF) systems, solution to MDOF systems, Eigen values and Eigen vectors

Unit 4: Seismic Analysis: Static Approach **(06 hours)**

Types of seismic analysis, IS 1893 code provisions, equivalent static analysis.

Unit 5: Seismic Analysis: Dynamic Approach **(06 hours)**

Dynamic analysis, IS 1893-2016 code provisions, response spectrum analysis

Unit 6: Seismic Design **(06 hours)**

Seismic design factors – building configuration, damping, torsion, ductility. Lateral load resisting

systems, moment resisting frames, shear walls, diaphragms, braced frames, IS: 1893 code provisions. Strength and ductility of steel and concrete structures, ductile detailing of steel and concrete structures, IS 13920 provisions.

Text books

01 Structural Dynamics: Theory and Computation, Mario Paz & William Leigh, Springer Publications

02 Earthquake Resistant Design of Structures, S. K. Duggal, Oxford Publications

03 Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited.

Reference book

01 Dynamics of Structures, A. K. Chopra, Pearson Education India.

Indian Standards

01 IS 1893 (Part 1): 2016 Reaffirmed in 2021, Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings, Bureau of Indian Standards, New Delhi. India.

02 IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi. India.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 015: Project Stage II

Teaching scheme	Credits	Examination scheme
Practical: 04 Hours/week	03	Term Work: 100 Marks
	02	Oral: 50 Marks

Pre-requisites
Fundamentals of Civil Engineering

Course objectives
01 Identify latest technical/practical problems in the field of Civil Engineering.
02 Inculcate the ability to describe, interpret and analyze technical content.
03 Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Appraise the current Civil Engineering research/techniques/developments/interdisciplinary areas.
02 Review and organize literature survey utilizing technical resources, journals etc.
03 Evaluate and draw conclusions related to technical content studied.
04 Demonstrate the ability to perform critical writing by preparing a technical report.
05 Develop technical writing and presentation skills.

Term Work

The Project Stage II report should contain the following. Internal guides may prepare a continuous evaluation sheet for each student and refer as continuous assessment for term work marks.

01 Introduction including aim and objective
02 Review of literature
03 Problem statement and methodology
03 Concepts associated with the project topic
04 Results and discussion
05 Validation of results
06 Conclusions and future scope of work
07 References
08 Students publication/achievements

In Project Work Stage II, the student shall complete the project and prepare the final report of project work in standard format duly certified for satisfactory completion of the project work by the concerned guide and Head of the Department/Institute. The final project report shall be submitted in hard bound copy as well as a soft copy. The term work of project stage II shall be assessed jointly by the pair of internal and external examiners, along with oral examination of the same. It is recommended that at least one publication on the project topic to be presented in a conference or published in a referred journal.

Oral Examination: The students must prepare presentation on Project Stage II and present in presence of pair of examiners through a viva-voce examination.

Savitribai Phule Pune University, Pune
B.E. Civil (2019 Pattern) w. e. f. July 2022
401016: Dams and Hydraulics Structures Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of following compulsory assignments. Oral examination is based on term work.

01 Literature collection of introductions to dams (minimum 5 dams) or case study of failure of any hydraulic structure.
02 Stability analysis of gravity dam
03 Design of profile of spillway
04 Design of energy dissipation device below the spillway
05 Stability analysis of zoned earthen dam (Preferably use of AutoCAD sheet)
06 Analysis of weirs on permeable foundations
07 Design of lined canal
08 Site visits and reports with photographs (compulsory) of the following.
Gravity dam/earthen dam
Spillway
CD/Canal structures/Weirs/Barrage

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 017: Quantity Surveying, Contracts and Tenders Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of following compulsory exercise. Oral examination is based on term work.

01 Detailed estimate of load bearing structure (for a single storied building), calculation of steel reinforcement by percentage basis, using rates as per current SSR.
02 Working out detailed quantities for two storied (G+1) R.C.C. framed building based on prevailing SSR.
03 Preparation of bar bending schedule for the G + 1 building as in exercise No. 2.
04 Detailed estimate for any one of the following
   a. Factory Shed of Steel Roof Truss
   b. Elevated Water Reservoir
   c. Pipe/Slab Culvert
   d. Road / Railway Track/Runway
05 Detailed specifications for major construction items of building/road.
06 Working out rate analysis for major construction items of building/road.
07 Preparation of tender documents for exercise No. 2 (Preparation of schedule A & B, conditions of contract regarding time, labour payment, etc.) and collection of tender notice for different government construction works (minimum 3)
08 Preparing valuation report of a Residential building and writing report using O-1 form
09 Appropriate software/excel spread sheet for exercise in serial No 1 to 4 is recommended.
10 Site visit and reports for understanding of BBS with photographs (Mandatory)

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 a Elective V: Earthquake Engineering Lab

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 50 Marks

Term Work

Term work consists of the following experiments or assignments. Term work marks will be based on continuous assessment.

01 Assignments on each unit.
02 Using any programming language or spreadsheets, plot the response functions for various types of excitations.
03 Demonstrate the applications of horizontal and vertical shake tables.
04 Perform seismic analysis of a multi-story building using any software.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401001: Foundation Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites

Engineering Mechanics and Soil Mechanics

Course objectives

01 To know various methods for subsurface investigations for foundations.
02 To learn to perform geotechnical design of shallow and deep foundations.
03 To study the problems related to foundations on expansive soil and ways to solve them.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Perform subsurface investigations for foundations using different methods.
02 Estimate the bearing capacity of shallow foundations.
03 Calculate immediate and primary consolidation settlement of shallow foundations.
04 Decide the capacity of a pile and pile group.
05 Understand the steps in geotechnical design of shallow foundations and well foundations.
06 Analyze problems related to expansive soil and overcome them using design principles, construction techniques in black cotton soil.

Course Content

Unit 1: Subsurface Investigations for Foundations **(06 hours)**

Purpose and planning of subsurface exploration, methods of Investigation: trial pits, borings, depth & number of exploration holes, core recovery, RQD, core log, geophysical methods: seismic refraction and electrical resistivity method, disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler, field tests- SPT, N value correction and significance, DCPT, SCPT and introduction of advanced testing techniques like pressure meter test, borelog, contents of sample soil investigation report.

Unit 2: Bearing Capacity **(06 hours)**

Basic definitions, modes of shear failure, bearing capacity analysis- Terzaghi's, Hanson's, Meyerhof's, Skempton's, Vesics equations and IS code method - rectangular and circular footings, bearing capacity evaluation: plate load test and SPT, Housel's perimeter shear concept, bearing capacity of layered soil, effect of water table on bearing capacity, effect of eccentricity, presumptive bearing capacity

Unit 3: Immediate and Consolidation Settlement **(06 hours)**

Immediate Settlement: introduction, causes of settlement, pressure bulb, contact pressure, significant depth of foundation, allowable settlement, differential settlement - I. S. criteria, components of settlement, use of plate load test and SPT in settlement analysis and allowable soil pressure.
Consolidation Settlement: introduction, spring analogy, Terzaghi's consolidation theory, laboratory consolidation test, determination of coefficient of consolidation- square root of time fitting method

and logarithm of time fitting method, time factor, rate of settlement and its applications in shallow foundations, introduction of normal consolidation, over consolidation and pre consolidation pressure.

Unit 4: Pile Foundations **(06 hours)**

Introduction: pile classification according to different criteria, pile installation - Cast in-situ, driven and bored pile, load carrying capacity of pile by static method, dynamic Methods: Engineering news formula, modified ENR formula and modified Hiley formula, pile load test and cyclic pile load test, group action: field rule, rigid block method, negative skin friction, settlement of pile group in cohesive soil by approximate method, uplift capacity of piles, micro piles.

Unit 5 Shallow foundations, Piers and Caissons **(06 hours)**

Shallow Foundations: types and applications, location and depth of footing, principles of design of footing, steps involved in proportioning of footing, proportioning of combined footings – rectangular, trapezoidal and strap footing, raft foundation- types, bearing capacity, floating raft, design of raft foundation- conventional (rigid) method and elastic (flexible) method (only design principles and steps, no numerical).

Piers and Caissons: definitions, types and uses, well foundation: components, sand island method, shapes of wells, tilts and shifts: precautionary and remedial measures, bearing capacity and depth of well foundation, forces acting on well foundations, lateral stability of well foundation – Terzaghi's method, IRC method, ultimate soil resistance method (only numerical on lateral stability analysis, no derivation for methods).

Unit 6: Cofferdams and Foundation on Black Cotton Soils **(06 hours)**

Cofferdams: types and applications, contiguous pile walls, RC Diaphragm wall method. Foundation on Black Cotton Soils: characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, swelling pressure measurement, foundations on black cotton soil: design principles, construction techniques, under reamed piles: design principles and its construction techniques, stone columns, pre loading with prefabricated vertical drains/sand drains.

Text books

01 Foundation Engineering by P. C. Varghese, PHI Learning Pvt. Ltd.
02 Soil Mechanics and Foundation Engineering by A. K. Arora, Standard Publishers.
03 Soil Mechanics and Foundation Engineering by V. N. S Murthy, Marcel Dekker, Inc. New york.
04 Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publicationselhi.

Reference books

01 Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. Rao, New Age International Publishers.
02 Principles of Foundation Engineering, Braja M. Das, PWS Publishing Company.
03 Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill.
04 Foundation Analysis and Design, J. E. Bowels, McGraw-Hill.
05 Geotechnical Engineering by Conduto, PHI, New Delhi.
06 Soil Mechanics & Foundation Engineering by Rao, Wiley

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401002: Transportation Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Infrastructural Engineering and Construction Materials

Course objectives
01 To learn principles and practices of transportation planning
02 To describe traffic studies, their analysis and their interpretation.
03 To learn Geometric Design of Cross Sectional Elements of pavement.
04 To study characteristic, properties and testing procedures of highway materials.
05 To enumerate different types of pavements and design of flexible and rigid pavement
06 To understand the fundamentals of Bridge Engineering and Railway Engineering

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand principles and practices of transportation planning.
02 Demonstrate knowledge of traffic studies, analysis and their interpretation.
03 Design Geometric Elements of road pavement.
04 Evaluate properties of highway materials as a part of road pavement.
05 Appraise different types of pavements and their design.
06 Understand the fundamentals of Bridge Engineering and Railway Engineering

Course Content

Unit 1: Highway development and planning **(06 hours)**
History , development plans, classification of roads, road patterns, road development in India: vision 2021, rural road development vision 2025, current road projects in India, highway alignment, highway project report preparation, (planning surveys & master plans based on saturation system).problems based on saturation system.

Unit 2: Traffic Engineering and control **(06 hours)**
Traffic characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control devices (signs, signals, islands, road markings), accident studies, types of road intersections, parking studies; highway lighting, problems.

Unit 3: Geometric design of highways **(06 hours)**
Introduction, highway cross section elements, sight distance, design of horizontal alignment, problems of horizontal alignment, design of vertical alignment, design of intersections.

Unit 4: Pavement materials **(06 hours)**
Materials used in highway construction and related tests: soil subgrade and CBR Test, stone aggregates, bituminous binders, bituminous paving mixes, viscosity based gradation of bitumen, modified bitumen cutbacks, emulsions, crumbed rubber modified bitumen, polymer modified bitumen, foamed bitumen, Marshall stability mix design and test (All 5 test parameters).

.Unit 5: Pavement Design **(06 hours)**

Introduction to various types of pavement, flexible pavements: computation of design traffic (vehicle damage factor, lane distribution factor, and traffic growth rate), flexible pavements, computation of design traffic, problems, stresses in flexible pavements, design guidelines for flexible pavements as per IRC 37-2018 without numerical. Rigid pavements: components and functions, factors affecting design, ESWL, Stresses in rigid pavements, wheel load stresses and temperature stresses, design guidelines for concrete pavements as per IRC 58-2015 without numerical, Joints in CC pavements, problems, highway drainage: subsurface and surface drainage.

Unit 6: Bridge and railway Engineering **(06 hours)**

Bridge Engineering: classification of bridges, components of bridges, preliminary data to be collected during investigation of site for bridges, economical span, afflux, HFL, scour depth and clearance, locations of piers and abutments, factors influencing the choice of bridge super structure, approach roads. Loads on bridges: brief specifications of different loads, forces and stresses coming on bridges as per IRC, Substructure: abutment, piers, and wing walls with their types. Railway Engineering: role and necessity of railway, merits of railways with respect to roadways and waterways, permanent way, component parts of permanent way, requirements of an ideal permanent way, gauge: types of gauges and their suitability

Text books

01 Highway Engineering, S. K. Khanna, C. E. G. Justo and A. Veeraragavan, Nem Chand and Brothers.

02 Principles and Practices of Highway Engineering, Dr. L .R. Kadiyali, Khanna Publishers Delhi

03 Principles of Highway Engineering and Traffic Analysis (4th edition), F. L. Mannering and Scott S. Washburn, Wiley India.

04 Highway and Bridge Engineering, B. L. Gupta and Amit Gupta, Standard publishers Distributors.

05 Principles of Railway Engineering, Rangwala, Charotar publication.

Reference books

01 A Course in Highway Engineering, S. P. Bindra, Dhanpat Rai and Sons.

02 Principles of Transportation Engineering, G. V. Rao, Tata MacGraw Hill Publication

03 Highway Engineering, Rangawala, Charotar publishing House.

04 Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, Prentice Hall of India Pvt. Ltd.

05 Railway Engineering, M M Agarwal

Indian Standards and Handbooks

01 IS 1201 to 1220 - 1978, IS 73, IS 2386 part I to V

02 IRC 58 - 2015, IRC37

03 Specifications for Road and Bridge works (MORTH) - IRC, New Delhi.

05 Specifications for Road and Bridge works (MORTH)-IRC, New Delhi.

06 Handbook of Road Technology, Lay M. G., Gorden Breach Science, Newyork

07 Civil Engineering Handbook, Khanna S. K.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401003 f Elective III: Operation Research

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Engineering maths and project management

Course objectives
01 Engineers with the ability to analyse the data for a given problem and formulate mathematical model
02 Engineers with ability to optimize linear & non-linear programming problems
03 Engineers with the ability to apply the knowledge for optimisation for Civil Engineering Projects

Course outcomes
On successful completion of this course, the learner will be able to,
01 Ccorrelate applications of Operations Research in Civil Engineering field
02 Solve the problems related to stochastic programming
03 Optimize transportation and assignment problems
04 Optimize linear problems
05 Optimize non-linear problems
06 Suggest solution for the problems related to dynamic models, games theory and replacement of items

Course Content

Unit 1: Introduction of Operations Research **(06 hours)**
Introduction to operations research and optimization techniques, applications of operations research in civil engineering, introduction to linear and non-linear programming methods, formulation of linear optimization models for civil engineering applications (objective function, constraints), graphical solutions to L P problems, local & global optima, unimodal function, convex and concave function.

Unit 2: Stochastic Programming **(06 hours)**
Sequencing: n jobs through 2, 3 and M machines, queuing theory: elements of queuing system and its operating characteristics, waiting time and ideal time costs, Kendall's notation, classification of Queuing models, single channel Queuing theory: Model I (Single channel Poisson Arrival with exponential services times, Infinite population (M/M/1): (FCFS/ /), simulation: Monte Carlo simulation.

Unit 3: Linear programming **(06 hours)**
The transportation model and its variants, assignment model and its variants

Unit 4: Linear programming **(06 hours)**
The simplex method, method of big M, two phase method, duality

Unit 5: Nonlinear programming **(06 hours)**

Single variable unconstrained optimization: sequential search techniques-dichotomous, Fibonacci, golden section, multivariable optimization without constraints: the gradient vector and hessian matrix, gradient techniques, steepest ascent/decent technique, Newton's Method, Multivariable optimization with equality constraints: Lagrange multiplier technique

Unit 6: Dynamic programming, Games Theory and Replacement Model **(06 hours)**

Dynamic programming: multi stage decision processes, principle of optimality, recursive equation, applications, Games theory: 2 persons games theory, various definitions, application of games theory, replacement of items whose maintenance and repair cost increase with time ignoring time value of money

Text Books

01 Operations Research, Premkumar Gupta and D. S. Hira, S. Chand Publications.
02 Engineering Optimization: Methods and Application, A. Ravindran and K. M. Ragsdell, Wiley India.
03 Engineering Optimization, S. S. Rao, New Age International (P) Ltd.
04 Quantitative Techniques in Management, N.D. Vohra, Mc Graw Hill
05 Operations Research, Pannerselvam - PHI publications.

Reference Books

01 Topics in Management Science, Robert E. Markland, Wiley Publication
02 A System Approach to Civil Engineering Planning & Design, Thomas K. Jewell - Harper Row Publishers
03 Operations Research, Hamdy A. Taha, Pearson Publication
04 Introduction to game theory, Stef Tijs, Hindustan Book Agency, New Delhi
05 Dynamic programming and optimal control, P. Bertsekas, Athena Scientific, Belmont.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401007 f Elective III: Operation Research Lab

Teaching scheme	Credit	Examination scheme
Practical: 02 Hours/week	01	Oral: 50 Marks

Term Work

Term work consists of the following. Oral examination based on term work.

01 One exercise/assignment on each unit.
02 Out of this any one exercise/assignment to be solved using Computer programming/ Software
03 One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution)
04 One exercise on analysis and solution using any of the above methods for data collected from Government Sources.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401011: Dams and Hydraulics Structures

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Prerequisites

Basic knowledge of Fluid Mechanics and Geotechnical Engineering

Course Objectives

01 To study different types of dams and instrumentation
02 To study the stability analysis of Gravity Dam
03 To study the spillways and design philosophy of Ogee spillway.
04 To study the failures and stability analysis of an earthen dam
05 To study design of canals and types of canal structures
06 Analysis of design of diversion headwork and of Cross drainage work

Course Outcomes

At the end of course the learner will be able to,
01 Understand types of dams and instrumentation working
02 Execute stability analysis of Gravity Dam
03 Understand types of spillways & Design of Ogee spillway
04 Illustrate the failures and analyze stability of earthen dam
05 Design Canals and understand the canal structures
06 Analysis of the Diversion headwork and Cross Drainage work

Course Content

Unit 1: Introduction to dam **(06 hours)**

Introduction, historical development of dams, different terms related to dams, selection of site of dam, factors governing selection of type of dam, classifications of dam, classification based on purpose, classification based on material, classification based on size of project, classification based on hydraulic action, classification based on structural action, introduction of arch dam and buttress dam including classification, advantages and limitations. Significance of Instrumentation: introduction, objectives of dam safety and instrumentation. Working principles and functions of instruments: piezometer, porous tube piezometer, pneumatic piezometer, vibrating wire piezometer, vibrating wire settlement cell, inclinometer, joint meter, pendulums, inverted pendulum, hanging pendulum, automatic pendulum coordinator, vibrating wire pressure cell, extensometer, embedment strain gauge, temperature gauge, distributed fiber optics temperature tool, seismograph.

Unit 2: Gravity Dam **(06 hours)**

Introduction, components of gravity dam, conditions favoring gravity dam, forces acting on gravity dam, combination of loading for design, seismic analysis of dam, terms related to seismic analysis, determination of seismic forces (Zangger's method), effect of horizontal earthquake acceleration, effect of vertical earthquake acceleration, stress analysis in gravity dam (only concept no derivation),vertical or normal stress, principal stresses, shear stresses, middle third rule, modes of failure of gravity dam, elementary profile of gravity dam, concept of high and low gravity dam, various design methods of gravity dam (introduction only), details of gravity method or 2 D method,

construction of gravity dam, colgrout masonry, roller compacted concrete (R.C.C), temperature controlling in mass concreting, crack formation in gravity dam, control of crack formation in dam, construction joints, keys, water seal, retrofitting.

UNIT 3: Spillway **(06 hours)**

Introduction, location of spillway, different key levels and heads in spillway, spillway capacity, components of spillway, approach channel, control structure, discharge channel, energy dissipation, energy dissipation device, tail channel, classification of spillway, classification based on operation, main or service spillway, auxiliary spillway, emergency spillway, classification based on gates, gated spillway, ungated spillway, classification based on features, straight drop spillway (free overflow spillway), saddle spillway, side channel spillway, overflow or ogee spillway, chute or open channel or trough spillway, shaft or morning glory spillway, siphon spillway, conduit or tunnel spillway, stepped spillway. Design of ogee spillway or overflow spillway, shape of crest, equations for spillway profile on upstream and downstream, energy dissipation below spillway, classification of energy dissipation devices, stilling basin, components of stilling basin, types of stilling basins, Indian Standard stilling basin, correlation between jump height and tail water depth, methods of energy dissipation for stilling basin, design of roller bucket and ski-jump bucket, introduction to orifice type of spillway and spillway gates.

Unit 4: Earthen dam **(06 Hours)**

Introduction, conditions favoring on earth dam, limitations of earth dam, classification of earth dam, classification based on materials, methods of construction, height; selection of type of earth dam, components of earth dam, requirements for safe design of earth dam, hydraulic (seepage) analysis, plotting of phreatic (seepage) line, homogeneous earth dam with horizontal drainage blanket, determination of seepage discharge using flow net. Composite earth dam with casing and hearting, properties of phreatic line, determination of seepage discharge through earth dam using flow net, structural stability analysis of homogeneous and zoned earth dam, forces acting on earth dam, method of stability analysis of an earth dam, procedure of analysis by Swedish slip circle method, fellenius method of locating center of critical slip circle, stability analysis for foundation, failure of earth dam, classification of failure of earth dams, hydraulic failure, seepage failure, structural failure, seepage control in earth dams, causes of seepage, seepage control measures, construction of earth dam.

Unit 5: Canals **(06 Hours)**

Introduction, classification of canals, classification based on alignment, classification based on soil, classification based on source of supply, classification based on discharge, classification based on lining, classification based on excavation, components of canal, data required for canal design, selection of canal alignment, design of stable canal in alluvial beds, Kennedy's theory, design of canal by Kennedy's theory, limitations of Kennedy's theory, Lacey's regime theory, design of canal by Lacey's theory, design of lined canal, canal lining, necessity of canal lining, requirement of lining material and types of lining. Canal Structures: canal falls, canal outlets, canal escapes, canal regulators.

Unit 6: Diversion head works **(06 Hours)**

Introduction, function of diversion head works, selection of sites for diversion head works, components of diversion head works, design of weir on permeable foundation, criteria for safe design of weir floor, brief introduction to Bligh and Lane's theory, Khosla's theory based on potential theory approach, Khosla's theory on independent variables, design of weirs on permeable foundations.

C. D. Works: Introduction, Necessity of Cross Drainage works, Selection of site for Cross Drainage work, Selection of suitable type of C. D. works, data required for design of cross drainage work, classification of cross drainage works. Drain over canal: siphon, super passage. Canal over drain: aqueduct, siphon aqueduct. Canal and drain water meeting at same level: level crossing, inlet and outlet, design considerations for cross drainage works.

Text books

01 Irrigation and Water Resources Engineering, Asawa G. L., New Age International (P) Ltd.
02 Irrigation Engineering and Hydraulic Structures, Garg S. K, Khanna Publication.
03 Irrigation Water Power Engineering, Punmia B. C., Laxmi Publication.

Reference Books

01 Design of Small Dams, United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co.
02 Design Textbook in Civil Engineering, Volume Six, Leliavsky, Serge-Oxford and IBH Publishing Co.Pvt. Ltd.
03 Irrigation, Water Resources and Water Power Engineering, Modi P. N., Standard Book House, New Delhi.

Indian Standards

01 IS 8605: 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, Third reprint, July 1999, Bureau of Indian Standards, New Delhi.
02 IS 6512: 1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, First reprint, September, 1998, Bureau of Indian Standards, New Delhi.
03 IS 457: 1957 (Reaffirmed 2005), Code of practice for general construction of plain and Reinforcement concrete for dam and other massive structures, sixth reprint, January 1987, Bureau of Indian Standards, New Delhi.
04 IS 1013: 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, Bureau of Indian Standards, New Delhi.
05 IS 14591: 1999, Temperature control mass concrete for dams - guidelines, Bureau of Indian Standards, New Delhi.
06 IS 11223: 1985, (Reaffirmed 2004), Guidelines for fixing Spillway capacity, edition 1.2 (1991-09), Bureau of Indian Standards, New Delhi.
07 IS 6934: 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways-Recommendation, First revision, Bureau of Indian Standards, New Delhi.
08 IS 11155: 1994, Construction of spillways and similar overflow structures- Code of practice, Bureau of Indian Standards, New Delhi.
09 IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
10 IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
11 IS 10317: 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, Bureau of Indian Standards, New Delhi.
12 IS 4997: 1968 (Reaffirmed 1995), Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, Bureau of Indian Standards, New Delhi.
13 IS 7365: 1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, Bureau of Indian Standards, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401012: Quantity Surveying, Contracts and Tenders

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks
		End semester exam: 70 Marks

Pre-requisites
Knowledge of building planning, roads and its structural components, construction materials

Course Objectives
01 Impart knowledge to prepare approximate and detailed estimate of Civil Engineering works
02 To teach concepts of tendering process, contract document & Arbitration
03 To draft detailed specification and work out rate analysis according to material, labor requirements as per specified norms.
04 Impart knowledge of valuation, depreciation to carry out valuation of properties

Course Outcomes
On successful completion of this course, the learner will be able to,
01 Understand concept of estimates and prepare approximate estimate for various for Civil Engineering works.
02 Describe tendering process, construction contracts, and aspects of Arbitration and prepare tender documents.
03 Prepare detailed estimate of various items of work by different methods and calculate quantity of steel from Bar bending schedule.
04 Apply engineering knowledge to prepare estimate for roads, culverts, and water tank (Elevated storage tank)
05 Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis report.
06 Evaluate depreciation and valuation of property on the basis of present condition, specifications and market trend.

Course Content

Unit 1: Introduction and Approximate Estimates **(06 hours)**
Definition of estimation, valuation, purpose, and data required for estimation, types, concept of item of work, different items of work of buildings, units and mode of measurement for different items of work, measurement form and abstract form (Bill of Quantities). Administrative approval and technical sanction, prime cost, provisional sum and provisional quantities, contingencies, rate analysis, lead statement, work charge establishment, centage charges, , contents of S. S. R. Approximate estimate: Methods of approximate estimate of Civil Engineering works: like building, roads, irrigation, water supply & sanitary works with numerical.

Unit-2: Tenders, Contracts and Arbitration **(06 hours)**
Tenders: Definition, detailed tendering process and procedure, conditions regarding earnest money, security deposit, retention money, pre and post qualification of contractors, 3 bid, 2 bid and single bid system, qualitative and quantitative evaluation of tenders, comparative statement, pre-bid conference, acceptance/ rejection of tenders, BOT & Global Tendering, E-tendering. PWD procedure for executing, works piecework, rate list and daily labor, introduction to registration as a contractor in PWD.

Contracts: definition, objectives & essentials of a valid contract as per Indian Contract Act (1872), types of contracts, conditions of contract- defective work, subletting, etc. termination of contract, defect liability period, liquidated damages, interim payment or running account bills, advance payment, secured advance, final bill. Arbitration: Introduction to arbitrations as per Indian Arbitration & Conciliation Act (1996) - meaning and need of arbitration, qualities and powers of an arbitrator.

Unit 3: Taking out quantities & Detailed estimate **(06 Hours)**

Detailed estimates: factors to be considered while preparing detailed estimate, methods of detailed estimate-PWD and Centre line method, taking out quantities for load bearing and R.C.C framed structures as per IS 1200, bill of quantities. Bar Bending Schedule: introduction to bar bending schedule and its importance, preparing bar bending schedule for RCC members of building.

Unit 4: Estimates of other construction works **(06 Hours)**

Earthwork for road construction, estimate of road/highway works, estimate of steel roof truss, estimate of a culvert, water tank (elevated storage tank).

Unit 5: Specifications and Rate Analysis **(06 Hours)**

Necessity of specifications, purpose, types, drafting detailed specifications for major items of Civil Engineering works like earthwork, PCC, Masonry (stone & brick), RCC, Plastering, flooring, painting and road, Rate Analysis: purpose, importance, factors affecting rate of an item of work, overheads, task-work, procedure for rate analysis, rate analysis for major items of civil engineering works- like earthwork, PCC, masonry-stone & brick, RCC structural elements, plastering, flooring.

Unit 6: Valuation **(06 Hours)**

Introduction, valuation- purpose, types of property-real property and personal property, meaning of price, cost and value, factors affecting value, gross income, net income, outgoings, various forms of values. concept of free hold and lease hold property, depreciation, methods of calculating depreciation, obsolescence, sinking fund, years purchase, annuity. Methods of valuation of land and building: rental basis, direct comparison method, profit based method, development method, and rent fixation for building. Methods of Valuation of land: belting method of land valuation and other methods.

Text books

01 A Textbook of Estimating and Costing (Civil), D D Kohli and R C Kohli, S. Chand & company, New Delhi.

02 Civil Engineering Contracts and Estimates, B. S. Patil, Universities press

03 A Text Book of Estimating and Costing for Civil Engineering, G.S. Birdie, Dhanpat Rai Publishing Company

Reference Books

01 Estimating and Costing in Civil Engineering: Theory and Practice, B. N Dutta and S. Dutta , 28th revised edition, CBS Publishers and distributors.

02 Estimating, Costing Specifications & valuation in Civil Engineering, M. Chakraborty.

03 Estimating and Costing, R. C. Rangwala, Charotar Publishing House Pvt Ltd, Anand.

04 Theory and Practice of Valuation, Dr. Roshan Namavati, Lakhani Publications.

05 Valuation Principles and Procedures, Ashok Nain, Dewpoint Publication.

06 Laws for Engineers, Dr. Vandana Bhat and Priyanka Vyas, ProCare.

Hand books and Indian Standards

01 Standard contract clauses for domestic bidding contracts: ministry of statistics and program implementation, Government of India.

02 Document: Federation International Des Ingenieurs Conseils (FIDIC) i.e. International Federation of Consulting Civil Engineers, Geneva, Switzerland.

03 Indian Practical Civil Engineers Handbook: P. N. Khanna, UBS Publication Distri. Pvt. Ltd.

04 Quantity Surveyor's Pocket Book by Duncan Cartlidge.

05 IS 1200: --- (Part 1 to 25): Methods of Measurement of Building & Civil Engineering Works, Bureau of Indian Standards, New Delhi.

06 IS 3861:1966, Method of measurement of areas and cubical contents of buildings, Bureau of Indian Standards, New Delhi.

07 D. S. R. (District Schedule of Rates) for current year.

08 PWD Redbooks, Vol 1 & 2.

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Savitribai Phule Pune University, Pune
B E Civil (2019 pattern) w. e. f. June 2021
401014 f: Elective VI: Rural Water Supply Engineering

Teaching scheme	Credits	Examination scheme
Lectures: 03 Hours/week	03	In semester exam: 30 Marks End semester exam: 70 Marks

Pre-requisites
Understanding of basic civil and environmental engineering

Course Objectives
01 Students will gain knowledge of techno-economic issues related to Rural Water Supply.
02 Students will study interdisciplinary aspects of water supply engineering.
03 Subject will make students understand administrative aspects related to water supply.

Course Outcomes
On successful completion of this course, the learner will be able to,
01 Understand issues related to rural water supply with respect to source, water related issues in rural areas.
02 Understand role of various government departments and importance of participatory approach.
03 Understand various types of rural water supply scheme and infrastructure requirements therein.
04 Understand interdisciplinary requirements in RWS including Software
05 Understand Automation requirements for a Water Supply Project
06 Understand Documentation and O and M issues related Water Supply Project including Leak Detection.

Course Contents

Unit I: Introduction to Water Related Issues **(06 hours)**
Source vis-à-vis population (e.g. up to 2000 ground water, > 2000 surface), introduction to reservation of water, permissions of concerned authorities to lift water from notified river, water related issues in rural areas, water supply scheme for single gram Panchayat/Group gram Panchayat, geology/ certificate from GSDA, geology and its relation with groundwater, strengthening of source, introduction to RWH, horizontal bore, hydro-fracturing, well sinking, unconventional methods by GSDA, retrofitting of schemes. use of weep holes, yield test of open well, tube and bore well, introduction to Shivkalin Pani Sathawan Yojana, water quality and quantity.

Unit II: Socio- Economic Aspects of WS Schemes **(06 hours)**
Various departments involved in water conservation, participatory approach for success of project, financial scheme available with department, case studies: such as Palsoshi (Bhor), Hiware Bazar, Lamkani-(Dhule) available with MJP, capacity building of villagers.

Unit III: Various Types of Rural Water Supply Schemes **(06 hours)**
Introduction to single village scheme, introduction to regional rural W. S. Scheme, use of available infrastructure if any, retrofitting to available infrastructure, various components and layout of W. S. Schemes, scour depth calculation for well on bank/in a river bed, intake- Jack well (pump house), slotted pipe galleries and trench galleries, percolation wel, connecting mains, recuperation test (owner's responsibility), introduction to rising main/gravity main, introduction to WTP SR-ESR/GSR/MBR, introduction to distribution, including house connection (Ferrule).

Unit IV: Interdisciplinary Aspects of Rural Water Supply **(06 hours)**

Introduction to electro mechanical aspects, pumping machinery, source-intake/WTP/ESR, introduction to hydraulic testing of pipelines, source: conveyance, selection of rising main and its appurtenances to control water hammer, flow, airlocks etc., introduction to pumps & pumping machinery, selection of types of pumps, calculation of hours of power required, requirements of electric supply (3 phase), availability of E. S. Software/Programmes for design of economical diameter of R. M., techno- economic comparison of various pipe materials (R. M./Gravity Main, as well as distribution lines), requirement of residual hydraulic pressure, calculation of hydraulic grade line HGL and frictional head with total head acting on pump, introduction to JALTANTRA software of IIT Bombay.

Unit V: Instrumentation in WSE **(06 hours)**

Introduction to auto pump controller, sensor for water quality monitoring cycle PH, turbidity meter, TDS meter, ultrasonic level sensor, hydraulic modeling, use of instrumentation and robotics in WSS, use of SCADA and introduction to SCADA based automation, PLC in WSE, application of GPS in WSE, application of GIS in WSE, introduction to the water meter, case study of Malakapur Town.

Unit VI: Documentation of Presentation **(06 hours)**

Record drawings of executed works, (As built drawings), periodical maintenance of pumping machinery, electrical components and other machinery, training requirements to villagers on operation and maintenance issues, introduction to preventive maintenance, leakage detection: techniques used and importance.

Text Books

01 Water Supply Engineering, S. K. Garg, Khanna Publications
02 Water Supply Engineering, Dr. P. N. Modi, Standard Book House

Reference Books

01 CPHEEO Manual on Water Supply and Treatment
02 Rural Water Supply And Sanitation by Sanjay Gupta
03 IWWA Technical Data Book (Available with IWWA Pune Local Centre)
04 Special Reference Material Recommended:
Compendium of Training Materials for the Capacity Building of the Faculty and Students of Engineering Colleges on Under the Unnat Maharashtra Abhiyan (UMA) Prepared By Institute for Resource Analysis and Policy, Hyderabad & CTARA, IIT Bombay Supported by UNICEF, Mumbai March, 2018

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