Savitribai Phule Pune University

Syllabus for SE (Civil Engineering) 2019 course

(To be implemented from June 2020)

Board of Studies in Civil Engineering

Faculty of Science and Technology

SPPU June 2020

SE Civil

Savitribai Phule Pune University, Pune
SE (Civil Engineering) 2019 Course
(With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	IN-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
201001	Building Technology and Architectural Planning	03	-	-	30	70	--	-	-	100	03	-	-	03
201002	Mechanics of structure	03	-	-	30	70	-	-	-	100	03	-	-	03
201003	Fluid Mechanics	03	-	-	30	70	-	-	-	100	03	-	-	03
207001	Engineering Mathematics III	03	-	01	30	70	25	-	-	125	03	-	01	04
207009	Engineering Geology	03	-	-	30	70	-	-	-	100	03	-	-	03
201004	Building Technology and Architectural Planning **Lab**	-	04	-	-	-	50	-	-	50	-	02	-	02
201005	Mechanics of structure **Lab**	-	04	-	-	-	-	-	50	50	-	02	-	02
201006	Fluid Mechanics **Lab**	-	02	-	-	-	-	-	50	50	-	01	-	01
207010	Engineering Geology **Lab**	-	02	-	-	-	25	-	-	25	-	01	-	01
201007	**Audit Course 1 Awareness to civil Engineering Practices / Road Safety Management / Foreign Language**	-	01	-	-	Grade	-	-	-	Grade	-	-	-	-
Total		15	13	01	150	350	100	-	100	700	**15**	**06**	**01**	**22**

Abbreviations:
TH: Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note: Interested students of S.E. (Civil) can opt any one of the audit courses from the list of audit coursesprescribed by BoS (Civil Engineering)

Note for all the courses: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self-study, NPTEL course lecture and/or using relevant ICT technique

Semester-IV														
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**			
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**PR**	**TUT**	**Total**
201008	Geotechnical Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
201009	Survey	03	-	-	30	70	-	-	-	100	03	-	-	03
201010	Concrete Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
201011	Structural Analysis	03	-	01	30	70	25	-	-	125	03	-	01	04
201012	Project management	03	-	-	30	70	-	-	-	100	03	-	-	03
201013	Geotechnical Engineering **Lab**	-	02	-	-	-	-	-	50	50	-	01	-	01
201014	Survey **Lab**	-	04	-	-	-	-	50	-	50	-	02	-	02
201015	Concrete Technology **Lab**	-	02	-	-	-	25	-	-	25	-	01	-	01
201017	Project Based Learning	-	04	-	-	-	50	-	-	50	-	02	-	02
201018	Audit Course II: Disaster Management	-	01	-	-	Grade	-	-	-	Grade	-	-	-	-
Total		15	13	01	150	350	100	50	50	700	**15**	**06**	**01**	**22**

Abbreviations:
TH: Theory TW: Term Work PR : Practical OR: Oral TUT : Tutorial

Note for all the courses: The Underlined portion of the syllabus will be covered by video lectures/ on-line lectures/ flip classroom, self-study, NPTEL course lectures and/or using relevant ICT technique

SEMESTER I

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201001 Building Technology and Architectural Planning

Credits: 03

Teaching Scheme:
Theory : 03hrs/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 doors and 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 offlooring.

Roofing Materials – galvanized iron pre-coated aluminum 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

Credits: 03

Teaching Scheme:
Theory : 03hrs/ 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 Shafts and 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 and maximum 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

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 relationshipsin 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

Unit II: (07 Hours)

a) Fluid Kinematics

Eulerian and Lagrangian approach, velocity and acceleration, and their components 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.

Unit III: (07 Hours)

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 factorfor 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)
207001 Engineering Mathematics III

Credits: **04**

Teaching Scheme:	**Examination Scheme:**
Theory : 03hrs/ week	In-semester : 30 Marks
Tutorial : 01hrs/week	End-semester : 70 Marks
	Term Work : 25 marks

Prerequisites:

Differential and Integral Calculus, Differential equations of first order and first degree, Fourier series, Collection, classification & representation of data, Permutations & combinations and Vector algebra.

Course Objectives:

To make the students familiarize with concepts and techniques in Ordinary & Partial differential equations, Numerical methods, Statistical methods, Probability theory and Vector calculus. The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:

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

1. Solve Higher order linear differential equations and its applications to modelling and analysing Civil engineering problems such as bending of beams, whirling of shafts and mass spring systems.
2. Solve System of linear equations using direct & iterative numerical techniques and develop solutions for ordinary differential equations using single step & multistep methods applied to hydraulics, geotechnics and structural systems.
3. Apply Statistical methods like correlation, regression and probability theory in data analysis and predictions in civil engineering.
4. Perform Vector differentiation &integration, analyze the vector fields and apply to fluid flow problems.
5. Solve Partial differential equations such as wave equation, one and two dimensional heat flow equations.

Course Contents:

Unit I: Linear Differential Equations (LDE) and Applications (08 Hours)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE.

Modelling of problems on bending of beams, whirling of shafts and mass spring systems.

Unit II: Numerical Methods (08 Hours)

Numerical solutions of system of linear equations: Gauss elimination method, Cholesky, Jacobi and Gauss-Seidel methods.
Numerical solutions of ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} order and Predictor-Corrector methods.

Unit III: Statistics and Probability (07 Hours)

Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates.
Probability, Probability density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test, t-test.

Unit IV: Vector Differential Calculus (08 Hours)

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications (08 Hours)

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion, Bernoulli's equation.

Unit VI: Applications of Partial Differential Equations (PDE) (07 Hours)

Basic concepts, modeling of Vibrating String, Wave equation, One and two dimensional Heat flow equations, method of Separation of variables, use of Fourier series, Applications of PDE to problems of Civil and allied Engineering.

Books:

Text Books:

1. Higher Engineering Mathematics by B.V. Ramana (Tata McGraw-Hill).
2. Higher Engineering Mathematics by B. S. Grewal (Khanna Publication, Delhi).

Reference Books:

1. Advanced Engineering Mathematics, 10e, by Erwin Kreyszig (Wiley India).
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).
3. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil (Cengage Learning).
4. Numerical Methods for Engineers,7e by S. C. Chapra and R. P. Canale (McGraw-Hill Education)
5. Introduction to Probability and Statistics for Engineers and Scientists, 5e, by Sheldon M. Ross (Elsevier Academic Press)
6. Partial Differential Equations for Scientists and Engineers by S. J. Farlow (Dover Publications, 1993)

Guidelines for Tutorial and Term Work:

Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.

Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
207009 Engineering Geology

Credits: 03

Teaching Scheme:
Theory : 03 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 therocks 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 typesand 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 Bor Ghat 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.

Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
201004 Building Technology and Architectural Planning –Lab

Credits: 02

Teaching Scheme:	**Examination Scheme:**
Practical : 04 hrs/week	Term Work : 50 Marks

List of Laboratory Assignments

1. Students shall prepare drawings of types of masonry and Brick bonds (Quarter plate)
2. Prepare sheet showing details of at least two Doors, windows and Arches. (Quarter plate)
3. Draw the line plans of any one residential building and any two Public Buildings (Graph Paper)
4. Perspective drawing of a small building element (Total 2 problems - 1 based on one point and two point each)
5. Floor Plan/ Typical floor plan with construction notes, schedule of openings, of any type of building, Plan, Elevation and Section on separate sheet **(Full Imperial sheet)**
6. Developing typical floor plan drawing exercise completed in assignment number 5, using CAD and Printout of the same.
7. Layout/ Site plan indicating water supply and drainage line (with area statement, make max. four students in one group).
8. **Site Visit:** Any on-going Construction Site (visit report should contain: details of the project, stage of construction, sketches of components with cross section & dimensions, materials used and site plan, etc.)

OR

8. Site Visit: **Green Building**, Salient features like materials used/technology etc, benefits, planning concepts of Green Building (site selection, orientation, sun pathand wind diagram etc.),
9. Document collection: Different sanction forms and at least six brochures of building materials

Report file:

1. It shall consist of data given for the project, Planning considerations and line plans, Design calculations.
2. Terminology of Perspective drawing
3. Dimension standards of Residential building and Public building
4. Visit Report

Savitribai Phule Pune University, Pune
Second Year of Civil Engineering– Sem I (2019 Course)
201005 Mechanics of Structures-Lab

Credits: 02

Teaching Scheme:	**Examination Scheme:**
Practical : 04 hrs/week	Oral : 50 Marks

List of Laboratory Experiments

Sr. No.	**Group A**
1	**Metals** 1. Tension test on mild and TMT steel. 2. Shear (Single & Double) test on mild steel. 3. Torsion test on mild steel. 4. Impact (Izod&Charpy) test on mild steel, aluminum, brass.
	Group B
2	**Timber & Ply wood** 1. Compression test on timber (Parallel & Perpendicular) 2. Bending test on timber and plywood.
	Group C
3	**Bricks &Tiles** 1. Field tests on bricks 2. Water absorption test on bricks. 3. Efflorescence test on bricks. 4. Compressive strength test on bricks 5. Flexural strength of flooring tiles. 6. Abrasion test of flooring tiles.
5	One Assignment on each unit of this subject.
6	Assignment on Influence Line Diagram (ILD) of Reactions, Shear Force and Bending moment of determinate beams.
7	Market survey of structural materials including its costing.
Oral : Based on above syllabus	

*** The concept explanation part can be taught through Online teaching mode, however, the problem solving needs offline mode.**

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
201006 : Fluid Mechanics - Lab
Credits: 01

Teaching Scheme:
Practical : 02hrs/week

Examination Scheme:
Oral : 50 Marks

The Term work shall consist of Experiments (09), Assignments (02) and Visit Report (01)

Term work:

A) Any nine experiments of below mentioned experiments, out of which **first seven are compulsory:**

1. Measurement of viscosity of fluid by Redwood/Saybolt viscometer.
2. Experimental verification of Bernoulli's theorem with reference to loss of energy.
3. Calibration of Venturimeter / Orifice meter.
4. Determination of Darcy-Weisbach friction factor (*f*) for a given pipe and study of variation of *f* with Reynolds Number (*Re*).
5. Flow around a Circular Cylinder/Aerofoil.
6. Study of Uniform Flow Formulae for Open channel.
7. Velocity Distribution in Open Channel Flow.
8. Calibration of Rectangular and Triangular Notch.
9. Determination of Stability of Floating Bodies using Ship Model
10. Drawing Flow net by Electrical Analogy for flow below Weir (with & without sheet pile)
11. Measurement of Pressure using different Pressure Measuring Devices (including Transducers /state of arts Digital Instruments also).
12. Measurement of Surface Tension.
13. Determination of Minor Losses in Pipes

B) Assignments: Any two assignments of below mentioned**. First assignment is compulsory.**

1. Analysis of pipe network using Hardy Cross Method (minimum two loops) – both by hand calculations and using computer any language/software solution.
2. Developing a Demo Model related to any fluid flow phenomenon (physical model/soft model).
3. Demonstration of any Software related to Fluid Mechanics/Hydraulics.
4. GVF computation using any computer Language/Software.

C) Site visit : Report on Site visit to any one of the Research Institute like **CWPRS, WALMI, MERI etc.**

Savitribai Phule Pune University, Pune

Second Year of Civil Engineering– Sem I (2019 Course)

207010 Engineering Geology - Lab

Credits: 01

Teaching Scheme:	**Examination Scheme:**
Practical : 02 hrs/week	Term Work : 25 Marks

List of Laboratory Assignments:

Following experiments are to be compulsorily performed. Term work shall consist of journal giving details of the experiments performed.

1. Megascopic identification of following mineral specimens (around 50).

Rock Forming Minerals, Economic Minerals and Ore Minerals such as:

Silica group: Rock Crystal, Rosy Quartz, Transparent Quartz, Milky Quartz, Smoky Quartz, Amethyst, Chalcedony, different varieties of Agate, Jasper Banded Hematite Jasper

Feldspar group: Orthoclase, Microcline, Plagioclase **Mica group**: Muscovite, Biotite

Olivine group: Olivine **Pyroxene group:** Augite, Diopside, Hypersthene, **Amphibole group**: Hornblende, Asbestos, **Zeolite and other group:** Apophyllite, Stilbite, different varieties of Calcite, Gypsum Tourmaline, Chromite, Limonite, Laterite, Kyanite, Graphite, Hematite, Micaceous Haematite, Pyrite, Garnet etc.

2. Megascopic identification of following different rock specimens. (Around 50).

a) Igneous Petrology: Plutonic, Hypabyssal, Volcanic Rocks and their varieties like Granites, Syenite, Pegmatite, Graphic Granite, Dolerite, Andesite, Diorite, Gabbro, Rhyolite, Pumice, Trachyte, All varieties of Basalt like Compact, Giant Phenocryst Basalt (GPB),Amygdaloidal, Pipe A.B, Volcanic Breccia, Tachylytes, Tuff breccia.

b) Sedimentary Rocks: Rudaceous, Areanceous, Argillaceous, Chemical and Organic Deposits: Laterite, Bauxite, Conglomerates, Secondary Breccia, varieties of Sandstones (Red), Grit,Arkose sandstone, Sandstone with Ripple marks, Sandstone (Current Bedding), Shahabad Limestone, Black Limestone (Cudappah), Stalactite Limestone, Oolitic limestone, Shelly Limestone, Mudstone, Shale (White), Shale (Yellow), Shale (Black).

c) Metamorphic Petrology: Contact Metamorphic rocks, Dynamothermal Metamorphic rocks: Quartzite's, Marbles, Phyllite, Slate, varieties of Schists (Mica Schist, Biotite Schist with Garnet, Muscovite Schist, Chlorite Schist, Hornblende Schist, Chlorite Schist, Talc Schist, Quartz Sericite Schist), varieties of Gniesses (Augen Gneiss, Hornblende Biotite Gneiss, Hornblende Gneiss), Khondalite, Charnockite, Amphibolite.

3. Interpretation and construction of geological sections from contoured geological maps (A. G. Series—IV Total 8 maps and 2 maps to be constructed by the faculty members.)

4. Solution of engineering geological problems such as alignment of dams, tunnels, roads, canals, bridges, etc. based on geological maps.

5. Logging of drill core and interpretation of drilling data with graphical representation of core log.

6. Two Site visits are desirable to study various geological features.

7. GRAM++ software and open source software like QGIS, ARCGIS software may be optional toperform.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
Awareness to Civil Engineering Practices
Audit Course I

Teaching Scheme:
Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Civil Engineering is the oldest engineering profession comprising of a variety of sub-disciplines such as Structural Engineering, Geotechnical, Water resources, Environmental Engineering, Construction technology, Transportation Engineering etc. Undergraduate programs are designed with different theoretical approaches on the application of basic sciences to solve different societal problems by engineering knowledge. However, there is a need to make the students aware about how the Civil Engineering industry operates and how theories taught in different courses are applied in practice. The students can learn from the experience gained from different workplaces such Civil Engineering consultancies, contracting companies, construction sites etc. The course aims to provide insight of the different practices followed by the industry such as use of different documents & contracts in Civil Engineering practice, drawings required, engineering ethics, duties and responsibilities of the engineers, site records and diaries, health and safety practices on site.

Course Objectives:
1. To provide basic overview of functioning of different Civil Engineering related industries / firms.
2. To create awareness about application of different drawings, contract documents in Civil Engineering.
3. To provide insight of code of ethics, duties and responsibilities, health and safety as a Civil Engineer.

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

CO1: Describe functioning/working of different types of industries/sectors in Civil Engineering.

CO2: Describe drawings and documents required and used in different Civil Engineering works.

CO3: Understand the importance of Code of Ethics to be practiced by a Civil Engineer and also understand the duties and responsibilities as a Civil Engineer.

CO4: Understand different health and safety practices on the site.

Course Contents (During 1hr. Practical Session per week)

Unit I: Sectors in Civil Engineering **(03 Hours.)**

Details of different Sectors/sub-disciplines in Civil Engineering along with the following details: description, eminent institutes in India & abroad, related research institutes, noteworthy projects, higher education, latest & ongoing research in the domain, jobs opportunities in government as well as private sector.

Suggestion for effective content delivery:

Lecture cum interaction by alumni of your college working in different sectors of Civil Engineering

Unit II: Drawings and Documents **(03 Hours.)**

Types of drawings in different construction projects. Contract agreement & other documents in different construction projects.

Suggestion for effective content delivery:

i.] Visit to various construction sites/ architectural firms/ structural engineering firms etc. to understand drawings, documents & working culture.

ii.] Lecture by professional practitioner

Unit III: Engineering Ethics **(03 Hours.)**

Introduction, moral issues and moral dilemmas. Code of ethics in Civil Engineering followed by Construction Industry Development Council (CIDC) of India, national & international associations and institutes. Effective case studies (Minimum 2 case studies).

Suggestion for effective content delivery:

Case study based content delivery method, Lecture by professional practitioner

Unit IV: Construction Site Safety **(03 Hours.)**

Importance of site safety. Different health and safety parameters during actual execution of Civil Engineering constructions. Safety measures: conventional and modern.

Suggestion for effective content delivery:

On site visit & lecture by professional practicing Safety Engineer.

Guidelines for Assessment (Any one or more of following but not limited to)

1. Group discussion
2. Presentation
3. Mini Project / Activity
4. Site visit report
5. Guest lecture report

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Pattern)
Road Safety Management
Audit Course I

Teaching Scheme:
Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory implementation of regulations have been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the world statistics; but the comparable proportion for accidents is substantially large. The need for strict enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as alsoin India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the important stake holders who are expected to follow the rules and policies
of the government in order to facilitate safety of individual and safe mobility of others.

Course Objectives:

1. To provide basic overview on road safety & traffic management issues in view of the alarming increase in vehicular population of the country.
2. To explain the engineering & legislative measures for road safety.
3. To discuss measures for improving road safety education levels among the public.

Course Outcomes:

On completion of the course, learners will be able to…
CO1: Summarize the existing road transport scenario of our country
CO2: Explain the method of road accident investigation
CO3: Describe the regulatory provisions needed for road safety
CO4: Identify the safety issues for a road and make use of IRC's road safety manual for conducting road safety audit.

Course Contents (During 1hr Practical Session per week)

Unit I: Existing Road Transport Scenario (02 Hours.)

Introduction, national & international statistics related to road transport. Factors responsible for increase in vehicle growth. Share of public transport: importance and current scenario (national & international)

Suggestion for effective content delivery: Displaying updated and authentic statistics & real time scenario images during the session.

Unit II: Road Accidents & its Investigation (03 Hours.)

Definition of road accident. National & international statistics related to road accidents. Causes of road accident. Remedies / Measures for control road accidents. Methods for accident investigation. Condition diagram & collision diagram. Black spots & its identification based on accident data.

Suggestion for effective content delivery:

i.] Activity related to drawing condition & collision diagram based on actual accident data. ii.] Activity related to identification of black spots based on actual accident data

Unit III: Motor Vehicle Act & Central Motor Vehicle Rules (03 Hours.)

The Motor Vehicle Act of 1988. Central Motor Vehicle Rules (CMVR) of 1989. Amendments to CMVR – 2017 & 2019.

Suggestion for effective content delivery:

i.] Guest lecture by RTO Officer / Traffic Police Officer.

ii.] Public awareness campaign

Unit IV: Road Safety Audit (RSA) (04 Hours.)

Introduction & importance of RSA. Methodology, phases and checklists for Road Safety Audit as per IRC SP: 88 – 2010 (Manual on Road Safety Audit)

Suggestion for effective content delivery:

Mini project – Conducting Road Safety Audit on minimum 2 km (both directions included) road stretch in the nearby vicinity.

Guidelines for Conduction (Any one or more of following but not limited to)

1. Guest Lectures.
2. Visits and reports.
3. Assist government authorities like Municipal corporations, RTO in Road Safety Audits
4. Mini Project

Guidelines for Assessment (Any one or more of following but not limited to)

1. Written Test
2. Practical Test
3. Presentation
4. Report

Savitribai Phule Pune University, Pune

Second Year Civil Engineering (2019 Pattern)

Foreign Language

Audit Course I

Teaching Scheme:

Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

The institute can offer any foreign language as audit course as per the teaching scheme depending upon the demand of the students and availability of the faculty

SEMESTER II

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201008 Geotechnical Engineering
Credits: 03

Teaching Scheme:
Theory : 03 hrs/week

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

Prerequisites:

Fundamentals of Physics, Mathematics, Engineering Mechanics

Course Objectives:

1. To describe soil properties, classification and its behavior under stress.
2. To learn methods for measurements and determination of index & engineering properties of soil.
3. To study the interaction between water and soil and the effects of static vs flowing water on soil strength

Course Outcomes:

On completion of the course, learner will be able to,
1. Identify and classify the soil based on the index properties and its formation process
2. Explain permeability and seepage analysis of soil by construction of flow net.
3. Illustrate the effect of compaction on soil and understand the basics of stress distribution.
4. Express shear strength of soil and its measurement under various drainage conditions.
5. Evaluate the earth pressure due to backfill on retaining structures by using different theories.
6. Analysis of stability of slopes for different types of soils.

Course Contents

Unit I: Introduction and Index Properties (06 Hours)

a) Introduction to Geotechnical Engineering and its applications to Civil Engineering. (Types of soil structure, major soil deposits of India), Field identification of soils. {Introduction to soil exploration: objective and purpose.}

b) Three phase soil system weight – volume relationships, Index properties of soil: Methods of determination and their significance. [IS and Unified Soil classification systems.]

Unit II: Permeability and Seepage. (06 Hours)

a) Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. (Laboratory measurement of permeability: Constant head method and Falling head method as per IS 2720.) {Field test for determination of permeability- Pumping in test and pumping out test as per IS 5529 Part-I.} Permeability of stratified soil deposits.

b) Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation). [Flow Net, properties and application]Flow Net construction for flow under sheet pile and earthen dam.

Unit III: Compaction and Stress Distribution. **(06 Hours)**

a) Compaction – Introduction, Comparison between compaction and consolidation. [Compaction tests- Standard Proctor test, Modified Proctor test]. Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. (Field compaction methods and compaction equipment for different types of soil), Placement water content, Field compaction control- use of compaction test result. {Proctor needle in field compaction control.}

b) Stress Distribution in Soils – Geostatic stress, Boussinesq's theory with assumptions for point load and circular load (with numerical), Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method.Approximate stress distribution method.

Unit IV: Shear Strength of Soil. **(06 Hours)**

a) Introduction – Shear strength an Engineering Property. Mohr's stress circle, Mohr- Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. [Peak and Residual shear strength], {factors affecting shear strength.} (Stress-strain behaviour of sands and clays.)

b) Measurement of Shear Strength – Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. Their suitability for different types of soils, advantages and disadvantages. Different drainage conditions for shear tests. (Sensitivity and thixotropi of cohesive soils.)

Unit V: Earth Pressure. **(06 Hours)**

a) Earth Pressure – Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. [Rankine's Theory: Earth pressure on Retaining wall due to submerged backfill.]

b) Backfill with uniform surcharge, backfill with sloping surface, layered backfill.

(Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure.)

Unit VI: Stability of Slopes. **(06 Hours)**

a) Stability of Slopes – Classification of slopes and their modes of failure, Stability of slope: i) Taylor's stability number, ii) Swedish slip circle method, iii) Friction circle method, iv) Bishop's method. (Infinite Slopes in cohesive and cohesion less soil,) {Landslides- Causes and remedial measures.}

Books:

Text Books:

1. Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Laxmi Publications.
2. Geotechnical Engineering by Shashi K. Gulati &Manoj Datta, TataMcGrawHill.
3. Geotechnical Engineering by T N Ramamurthy & T G Sitharam, S Chand Publications.

Reference Books:

1. Geotechnical Engineering by C. Venkatramaiah, New Age International Publishers.
2. Principles of Geotechnical Engineering by Braj M. Das, Cengage Learning.
3. Geotechnical Engineering by P. Purushothma Raj, Tata Mc GrawHill.
4. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education.
5. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International.
6. Physical and Geotechnical Properties of Soils by Joseph E. Bowles, InternationalStudents Edition.

e-Resources:

1. http://ascelibrary.org/page/books/s-gsp.
2. http://accessengineeringlibrary.com/browse/geotechnical-engineersportable-handbook-second edition.
3. http://nptel.ac.in/courses/105101084/
4. http://nptel.ac.in/courses/105106142/

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201009 Survey
Credits : **03**

Teaching Scheme:
Theory: 03hrs/ week

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

Pre- requisites:
Basic Introduction to Civil Engineering field, Engineering Mathematics

Course Objectives:
With the successful completion of the course, the student should have the capability to:

1 Describe the function of surveying in civil engineering construction,
2 Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, and angular measurements,
3 Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-loop traverses,
4 Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments.
5 Be able to identify hazardous environments and take measures to insure one's personal and team safety
6 Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations and plotting.
7 Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system,
8 Work as a team member on a surveying party to achieve a common goal of accurate and timely project completion,
9 Calculate, design and establish curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, and earthwork quantities.

Course Outcomes:
On successful completion of this course, Student will be able to:

1. Define and Explain basics of plane surveying and differentiate the instruments used for it**.**
2. Express proficiency in handling surveying equipment and analyse the surveying data from these equipment.
3. Describe different methods of surveying and find relative positions of points on the surface of earth.
4. Execute curve setting for civil engineering projects such as roads, railways etc.
5. Articulate advancements in surveying such as space based positioning systems

6. Differentiate map and aerial photographs, also interpret aerial photographs.

Course Contents

Unit I: Compass and Levelling. **(08 Hours)**

a) Definition and Importance of Surveying; Principles of Surveying,

b) Definition, objective and fundamental classification of surveying (Plane and Geodetic), concept of Scale, Ranging, Chaining, Offsetting and Traversing. Construction and use of prismatic compass, Concept of bearing &, types of bearings such as Whole Circle Bearing, Quadrental Bearing, meridian and their types, local attraction and correction for local attraction, dip, declination and calculation of true bearings, including numericals of all types.

c) Equipment required for plane table surveying, uses, advantages and disadvantages and errors in plane table surveying. Methods of plane table Survey Radiation, intersection, traversing and resection –

d) Introduction to leveling, Types of leveling, Types of benchmarks, Study and use of dumpy level, auto level, digital level and laser level in construction industry, principal axes of dumpy level, testing and permanent adjustments reciprocal leveling, curvature and refraction corrections, distance to the visible horizon. Collimation Plane Method, Rise & Fall Method

Unit II: Theodolite Surveying **(08 Hours)**

a) Study of vernier transit 20" theodolite, uses of theodolite for measurement of horizontal angles by repetition and reiteration, vertical angles, measurement of deflection angles using transit theodolite and magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.

b) Theodolite traversing – computation of consecutive and independent co-ordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gales traverse table. Checks, omitted measurements, area calculation by independent co-ordinates.

Unit III: Tacheometry and Contouring. **(06 Hours)**

a) **Tacheometry –** applications and limitations, principle of stadia tacheometry, fixed hair method with vertical staff to determine horizontal distances and elevations of points, finding tacheometric constants. Tacheometric contouring. Numericals

b) **Contouring** – Definition of Contours, Characteristics of Contours, Contour Patterns for various natural features, direct and indirect methods of contouring, uses of contour maps, study and use of topo-sheets, profile leveling and cross-sectioning and their applications

Unit IV: Curves. **(07 Hours)**

Introduction to horizontal and vertical curves (including numericals but derivation not expected), different types of curves and their applications, simple and compound circular curves, elements and setting out by linear methods such as radial and perpendicular offsets, offsets from long chord, successive bisection of chord and offsets from chords produced. Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves and compound curves to be asked), Transition curves: necessity.

Unit V: Construction Survey & Modern Techniques such as Space Based Positioning System (SBPS) (06 Hours)

a. Introduction to construction survey, establishing of horizontal and vertical controls, setting out of buildings, maintaining verticality of tall buildings, survey for open traverse (roadway, railways, drainage lines, water lines, canals)., Setting out of a bridge, Determination of the length of the central line and the location of piers. Setting out of a tunnel – Surface setting out and transferring the alignment underground.

b. Introduction to SBPS, SBPS systems - GPS, GLONASS, Galileo, GAGAN, BeiDou and their features, Segments of SBPS (Space, Control and User), applications of SBPS in surveying.

Unit VI: Introduction to Geodetic Survey, Hydrograph Survey & Aerial Photogrammetry (07 Hours)

Introduction to Geodetic Survey, Objects, Methods of Geodetic Surveying, Introduction to triangulation and trilateration, Objective of triangulations surveys, Classification of triangulation systems, Triangulation figures, Strength of figure, Study and use of one second theodolite and Electronic Total Station,

Introduction to Hydrographic Survey Objects, Applications, Shore line survey, Sounding, Sounding equipment, Methods of Sounding & Sounding Equipment, Stream gauging,

Three point problem

Aerial Photogrammetry Objects, Classification- qualitative & quantitative photogrammetry, Applications, comparison of Map and aerial photographs, Flight Planning , Calculation of no of Photographs.

Books:

Text Books:

1. Surveying and Levelling Vol. I and Vol. II by T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan.
2. Surveying, Vol. I & II by Dr. B. C. Punmia, Ashok K. Jain, Arun K. Jain, Laxmi Publications.
3. Plane Surveying & Higher Surveying by Dr A. M. Chandra, New age international publishers New Delhi.

Reference Books:

1. GPS Satellite Surveying—Alfred Leick—Wiley
2. Principles of Geographical Information System—Burrough-- Oxford University Press
3. Surveying—M. D. Saikia—PHI Learning Pvt. Ltd. Delhi
4. Advanced Surveying -Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathikumar and N. Madhu, Pearson publication
5. Surveying & levelling by R. Subramanian, Oxford Publication.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering
201010 Concrete Technology
Credits: 03

Teaching Scheme:
Theory : 03 hrs/week

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

Course Objectives:
1. To know properties of various ingredients of concrete and concept of mix design.
2. To learn the behavior and properties of concrete in fresh and hardened state.
3. To understand special concrete and their applications.
4. To understand the durability aspects and preventive measures to enhance the fife of concrete.

Course Outcomes:
1. Able to select the various ingredients of concrete and its suitable proportion to achieved desired strength.
2. Able to check the properties of concrete in fresh and hardened state.
3. Get acquainted to concreting equipments, techniques and different types of special concrete.
4. Able to predict deteriorations in concrete and get acquainted to various repairing methods and techniques.

Course Contents

Unit I: Introduction to Concrete and Ingredients of Concrete. (06 Hours)

a) Cement and Aggregate– Manufacture, chemical composition, hydration, physical and mechanical properties, classification, types and application of cement, tests on cement, Classification of aggregate, physical and mechanical properties of aggregate, deleterious materialsin aggregate, alkali-aggregate reaction, Fineness and gradation of aggregates using sieve analysis, tests on aggregates.

b) Water and Admixtures –Quality of water for use in concrete, role of admixture, classification and types of admixtures like accelerators, retarders, plasticizers, super plasticizers, mineral admixtures-fly ash, silica fume, ground granulated blast furnace slag.

Unit II: Production, Properties and Testing of Fresh Concrete (06 Hours)

a) Production and Properties of Fresh Concrete: Nominal mixes, Water-cement ratio, Process of manufacturing fresh concrete-batching, mixing, transportation, compaction, curing of concrete, curing methods, influence of temperature, maturity rule, workability and factors affecting workability, cohesion and segregation.

b) Tests on fresh concrete – Workability by slump cone, compaction factor, Vee-Bee consistometer and flow table apparatus, Effect of admixture on workability of concrete and optimum dosage of admixture by Marsh cone test.

Unit III: Properties and Testing of Hardened Concrete (06 Hours)

a) Hardened concrete – Strength of concrete, factors affecting strength, micro-cracking and stress-strain relationship, relation between tensile and compression strength, impact strength, abrasion resistance, creep and shrinkage.

b) Testing of hardened concrete –Destructive tests -compression strength, flexural strength, indirect tensile strength, core test. Nondestructive tests: rebound hammer, ultrasonic pulse velocity, pullout test and impact echo test.

Unit IV: Concrete Mix Design and Methods of Mix Design (06 Hours)

a) Concrete Mix Design– Concept and objectives of concrete mix design, factors affecting the mixdesign, quality control, variability of laboratory test result, acceptance criteria, Grade designationand IS requirements as per IS 456 (Exposure conditions, minimum & maximum cement contentand maximum W/C ratio

b) Methods of Mix Design: IS code method and DOE method (with and without mineral admixture), Use of spreadsheet/programming/ software for concrete mix design.

Unit V: Concreting Equipments, Techniques and Special concretes (06 Hours)

a) Concreting Equipments and Techniques–Batching plants, concrete mixers, hauling, pumps, concrete vibrators and compaction equipments. Special concreting techniques- ready mix concrete, under water concreting, roller compacted concrete, cold and hot weather concreting.

b) Special concretes – Light weight concrete and its types, foam concrete, no fines concrete, self-compacting concrete, high density concrete, fiber reinforced concrete, geo-polymer concrete and Ferrocement technique.

Unit VI: Deterioration and Repairs in Concrete (06 Hours)

a) Deterioration –Durability, factors affecting the durability of concrete, Permeability, sulphate attack, acid attack, chloride attack, corrosion of reinforcement, carbonation of concrete

b) Repairs – Symptoms and diagnosis of distress, evaluation of cracks, selection of repair procedure, repair of defects using various types and techniques – shotcrete and grouting. Introduction to retrofitting of concrete structures by fiber reinforced polymer (FRP), polymer impregnated concrete. Corrosion monitoring and preventive measures.

Books:

Text Books:

1. Concrete Technology by M. S. Shetty, S Chand,New Delhi-110055.
2. Concrete Technology by M. L. Gambhir, Tata McGraw-Hill.
3. Concrete technology by A. M. Neville, J.J. Brooks, Pearson.

Reference Books:

1. Concrete Technology by A. R. Shantakumar, Oxford University Press, 2018.
2. Properties of Concrete by A. M. Neville, Longman Publishers.
3. Concrete Technology by R.S. Varshney, Oxford and IBH.
4. Microstructure and Properties of Concrete by P. Kumar Mehta, Prentice Hall.
5. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
6. Concrete Structures, Repair, Rehabilitation and Retrofitting by J. Bhattacharjee, CBS Publishers & Distributors Pvt. Ltd.
7. Durability Design of Concrete Structures, by A. Sarja and E. Vesiari, E & FN Spon Publication, 1996.

IS Codes : Latest revised editions of IS codes: IS 456, IS 269, IS 1489, IS 4031, IS 383, IS 2386, IS 9103, IS 516, IS 1199, IS 10262, SP 23.IS 13311.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201011: Structural Analysis

Credits : 04

Teaching Scheme:	**Examination Scheme:**	
Theory : 03 hrs/week	In-semester	: 30 Marks
Tutorial : 01 hrs/week	End-semester	: 70 Marks
	Term Work	: 25 Marks

Prerequisites:

Fundamentals of Physics, Mathematics, Engineering Mechanics and Mechanics of Structures

Course Objectives:

1. This subject will build on the concepts from Engineering Mechanics and Mechanics of Structures.
2. This will create a foundation for analyzing real life structures by imparting knowledge about various methods involved in the analysis of indeterminate structures.

Course Outcomes:

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

1. Understand the basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.
2. Analyze redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.
3. Implement application of the slope deflection method to beams and portal frames.
4. Analyze beams and portal frames using moment distribution method.
5. Determine response of beams and portal frames using structure approach of stiffness matrix method.
6. Apply the concepts of plastic analysis in the analysis of steel structures.

Course Contents

Unit I: Fundamentals of structure and analysis of redundant beams. (07 Hours)

a) Types and classification of structures based on structural forms, concept of indeterminacy, static and kinematics degree of indeterminacy.

b) Analysis of propped cantilever, fixed beam and continuous beams with indeterminacy up to second degree by strain energy method.

Unit II: Analysis of redundant pin jointed frames and multi-storied multi-bay 2-D rigid jointed frames. (07Hours)

a) Analysis of redundant trusses by unit load method for external loading, lack of fit, sinking of support and temperature changes (indeterminacy up to second degree).

b) Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Cantilever method and Portal method.

Unit III: Slope-Deflection Method. **(07 Hours)**

a) Slope-deflection equations, equilibrium equation of Slope-deflection method, application of Slope deflection method to beams with and without joint translation and rotation, yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid joint rectangular single bay single storey portal frames using Slope-deflection method. (Involving not more than three unknowns)

Unit IV: Moment Distribution Method. **(07 Hours)**

a) Stiffness factor, carry over factor, distribution factor, application of Moment distribution method of analysis to beams with and without joint translation and yielding of support, application to non-sway rigid jointed rectangular portal frames, shear force and bending moment diagram.

b) Sway analysis of rigid jointed rectangular single bay single storey portal frames using Moment distribution method (Involving not more than three unknowns).

Unit V: Stiffness method. **(07Hours)**

a) Fundamental concepts of flexibility and stiffness, relation between them. Stiffness method of analysis- Structure approach only. Application to beams (Involving not more than three unknowns).

b) Application of Stiffness structure approach to rigid jointed rectangular portal frames (Involving not more than three unknowns).

Unit VI: Plastic Analysis of Structure. **(07Hours)**

True and idealized stress-strain curve for mild steel in tension, stress distribution in elastic, elasto-plastic and plastic stage, concept of plastic hinge and collapse mechanism, static and kinematic methods of analysis, upper bound, lower bound and uniqueness theorem. Plastic modulus of section, Plastic moment, shape factor. Plastic analysis of determinate and indeterminate beams, single bay single storied portal frame.

Books:

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Ltd.
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd.
3. Structural Analysis: A Matrix Approach by G.S.Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited.

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd.
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd.
4. Structural Analysis by R. C. Hibbler, Pearson Education.
5. The Plastic Methods of Structural Analysis by B. G. Neal, Champman& Hall.
6. Structural Analysis by AslamKassimali, Cengage Learning India Private Limited
7. Matrix Analysis of Framed Structures by William Weaver Jr. and James M. Gere, Springer

Tutorial: Every student should solve at least five problems on each unit covering all the topics listed in syllabus. The TW marks will be based on the tutorial.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201012 Project Management
Credits : 03

Teaching Scheme:
Theory: 3hrs / week

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

Prerequisites:
Fundamentals of Management, Indian Construction Industry, Economics.

Course Objectives:
Students will be able to:
1. **Describe** the various concepts involved in Project Management.
2. **Explain** scientific methods of planning and management
3. **Segregate** the materials as per their annual usage and **explain** process to find production rate of construction equipment
4. **Demonstrates** methods of manpower planning and **Use** various project monitoring methods.
5. **Discuss** engineering economics and different laws associated with project management.
6. **Differentiate** the methods of project selection and **recommend** the best economical project.

Course Outcomes:
On completion of the course, student will:
1. **Describe** project life cycle and the domains of Project Management.
2. **Explain** networking methods and their applications in planning and management
3. **Categorize** the materials as per their annual usage and also **Calculate** production rate of construction equipment
4. **Demonstrates** resource allocation techniques and **apply** it for manpower planning.
5. **Understand** economical terms and different laws associated with project management
6. **Apply** the methods of project selection and **recommend** the best economical project.

Course Contents:

UNIT I Introduction to Project Management (06 Hours)

Importance, Objectives & Functions of Management, Principles of Management, Categories of Project, Project Failure, Project--- Life Cycle Concept and Cost Components, Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and Certified Project Management Professionals (PMP). Importance of Organizational Structure in Management- Authority / Responsibility Relation, Management By Objectives (MBO)

UNIT II Project Planning and Scheduling (06 Hours)

WBS – Work Breakdown Structure, Gantt / Bar chart & its Limitations, Network Planning, Network analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical Path and Type of Floats, Precedence Network Analysis (A.O.N.), Types of Precedence Relationship, P. E. R.T. Analysis

UNIT III Project Resources and Site Planning (06 Hours)

Objectives of Materials Management – Primary and Secondary Material Procurement Procedures -

Material Requirement - Raising of Indents, Receipts, Inspection, Storage, Delivery, Record Keeping – Use of Excel Sheets, ERP Software, Inventory Control - ABC Analysis, EOQ, Introduction to Equipment Management – Fleet Management, Productivity Studies, Site Layout and Planning, Safety Norms – Measures and Precautions on Site, Implementation of Safety Programs

UNIT IV Project Monitoring and Control (06 Hours)

Resource Allocation – Resource Smoothening and Leveling, Network Crashing – Time- Cost – Resource Optimization, Project Monitoring - Methods, Updating and Earned Value Analysis, Introduction to Use of Project Management Software's – MS Project / Primavera, Case study on Housing Project Scheduling for a Small Project with Minimum 25 Activities.

UNIT V Project Economics (06 Hours)

Introduction to Project Economics - Definition, Principles, Importance in Construction Industry, Difference between Cost, Value, Price, Rent, Simple and Compound Interest, Profit, Cash flow Diagram, Annuities and its Types, Demand, Demand Schedule, Law of Demand, Demand Curve, Elasticity of Demand and Supply, Supply Schedule, Supply Curve, Elasticity of Supply Equilibrium, Equilibrium Price, Equilibrium Amount, Factors Affecting Price Determination, Law of Diminishing Marginal Utility, Law of Substitution, Concept of Cost of Capital, Time Value of Money, Sources of Project Finance.

UNIT VI Project Appraisal (06 Hours)

Types of Appraisals such as Political, Social, Environmental, Techno-Legal, Financial and Economical, Criteria for Project Selection - Benefit - Cost Analysis, NPV, IRR, Pay-Back Period, Break Even Analysis [Fundamental and Application Component], Study of Project Feasibility Report and Detailed Project Report (DPR), Role of Project Management Consultants in Pre-Tender and Post-Tender.

Books:

Text Books:

1. Project planning and Control with PERT and CPM by DR. B.C. Punmia and K.K.Khadelwal Publisher: Firewall Media, Laxmi publication New Delhi.
2. Project management Principles and Techniques by B.B. Goel Publisher: Deep and Deep publisher

Reference Books:

1. Project Management—Khatua—Oxford University
2. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
3. Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
4. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
5. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
6. Total Quality Management - Dr. S. Rajaram and Dr. M. Sivakumar-- Biztantra
7. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.
8. Engineering Economics by R. Panneerselvam Publisher-PHI Learning; 2nd edition (2014)

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201013 Geotechnical Engineering-Lab

Credits : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs / week	Oral : 50 Marks

List of Laboratory Experiments / Assignments

The term work shall consist of a journal giving details of at least 11 out of 13 of the following experiments.

1. Water content determination by any two methods a) Oven drying method, b) Infrared moisture method, c) calcium carbide method
2. Specific gravity determination by Pycnometer /density bottle.
3. Sieve analysis, particle size determination and IS classification as per I.S. Codes.
4. Determination of Consistency limits and their use in soil classification as per I.S. Codes.
5. Field density test by a) Core cutter b) Sand Replacement and c) Clod method
6. Determination of coefficient of permeability by a) Constant head and b) Variable head method.
7. Direct shear test.
8. Unconfined compression test.
9. Vane Shear test.
10. Triaxial test
11. Standard Proctor test / Modified Proctor test.
12. Differential free swell test.
13. Swelling Pressure test
14. **Assignments on the following topics** (Any 2):
    a) Rebhann's and Cullman's graphical method for determination of earth pressure.
    b) Solution of problems on shear strength parameters using graph.
    c) Collection of sample soil investigation report for any construction project.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201014: Survey - Lab
Credit: 02

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs / week	Practical : 50 Marks

List of Laboratory Experiments

a) Perform any Eight Experiments out of 1 to 10 and Any 02 assignments & projects are mandatory:

1. Measurement of magnetic bearings of sides of a triangle or quadrilateral, correction for local attraction and calculations of true bearings using prismatic compass.
2. Plane table survey consisting of both Radiation and Intersection method. Actual mapping of small structure like an area map from central commanding area / small building using combination of both methods.
3. Finding horizontal distance and vertical elevation using a Tacheometer.
4. Simple and differential levelling with at least three change points using digital level.
5. Measurement of horizontal angles (by repetition method) and vertical angles using 1" and 20" Vernier Transit Theodolite. Setting the required horizontal and vertical angles
6. Setting out a circular curve by Rankine's method of deflection angles.
7. Setting out a building from a given foundation plan (minimum six co-ordinates)
8. Study and use of nautical sextant and measurement of horizontal angles
9. Study of the instruments used in hydrographic surveying.
10. Practical based on various special functions available in a total station such as remote elevation measurements, remote distance measurements and co-ordinate stakeout.

Mandatory Assignments: (Minimum 02)

1. Spatial database creation by using GIS software like Google earth or any other.
2. Brief Introduction to City Survey.
3. Study of aerial photograph and finding out the scale of the photograph.
4. Determination of air base distance using mirror stereoscope.

b) Projects:(Minimum Two)

1. Road project using Auto level for a minimum length of 100 m including fixing of alignment, profile levelling, cross-sectioning, plotting of L section and Cross Section. (One full imperial sheet including plan, L-section and any three typical Cross-section.

2. Tachometric contouring project on hilly area with at least two instrument stations about 60 m to 100 m apart and generating contours using both methods, manual as well as using any suitable software such as Autodesk land desktop, Auto-civil, Foresight etc. (minimum contour interval 1 meter).

3. Total Station Traversing

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201015 Concrete Technology - Lab

Credits : 01

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs / week	Term work : 25 Marks

List of Laboratory Assignments

The term work shall consist of a journal giving details of all the following experiments.

A] Cementitious materials:

1. Fineness of cement and fly ash (by sieve method)
2. Standard consistency Initial and final setting time and Soundness of cement.
3. Compressive strength of cement
4. Tensile strength of cement (**Optional**)

* Fineness of cement by Blains Air permeability method (**Video demo**)

* Soundness of cement by Autoclave method (**Video demo**)

B] Filler Materials (Fine & coarse aggregate)

1. Fineness modulus, Moisture content, silt content, bulk density and specific gravity of fine aggregate.
2. Fineness modulus, Moisture content, water absorption, bulk density and specific gravity of coarse aggregate.

C] Concrete

1. Concrete mix design by IS code method and DOE **using spread sheet/excel sheet**.
2. Workability of concrete with and without admixture by slump cone, compaction factor, and or Vee-Bee Consistometer apparatus.
3. Compressive strength test of concrete on cubes by destructive and non-destructive method rebound Hammer and Quality of concrete by ultra-sonic pulse velocity (**demo Video**).
4. Compressive strength test of concrete on cylinder (Stress –strain behavior- **demo Video**).
5. Indirect tensile strength and flexural strength of hardened concrete.
6. Site visit to RMC plant.

Savitribai Phule Pune University, Pune
Second Year Civil Engineering (2019 Course)
201017 Project Based Learning
Credits: 02

Teaching Scheme:
Practical : 04hrs/week

Examination Scheme:
Term Work: 50 Marks

Preamble:
Project Based Learning (PBL) was introduced in curriculum of First Year Engineering in Semester II (Course code- 110013) in 2019 course. In that course, students in group might have planned, managed and completed a task/ project/ activity which addressed the stated problem. In a continuation with this, PBL is introduced in core course of Civil Engineering. PBL demonstrates the power of student projects to develop college, community connections, applied research skills and higher levels of student thinking. PBL is a dynamic approach to teaching in which students explore real-world problems and challenges simultaneously developing 21st century Civil Engineering skills while working in collaborative groups. The aim of this course is to demonstrate the important attributes like communication, presentation, organization, time management, research, inquiry, self-assessment, group participation, leadership and critical thinking. Performance assessed on an individual basis and takes into account the quality of task/project/activity completed, the depth of content understanding demonstrated and the contributions made to the ongoing process of project realization. PBL allows students to reflect upon their own ideas and opinions and make decisions that affect project outcomes and the learning process in general.

Course Objectives:
1. To engage students in constructive learning environment and develop self-learning abilities.
2. To develop critical thinking and solving civil engineering problems by exploring and proposing sustainable solutions.
3. To integrate knowledge and skills from civil and other engineering areas.
4. To develop professional skills and project management.

Course Outcomes:
After completion of course the students will be able to
1. Identify the community/ practical/ societal needs and convert the idea into a product/ process/ service.
2. Analyse and design the physical/ mathematical/ ICT model in order to solve identified problem/project.
3. Create, work in team and applying the solution in practical way to specific problem.

Course Content
- Introduction to Project Based Learning, Traditional vs. Cognitive Learning, Why PBL? , Principles of Problem Design Seven Steps of Problem Design, Online PBL, Applications and Research Trends Case Studies in Civil Engineering.

Group Structure:

- Working in mentor – monitored groups. The students identify, plan, manage and complete a task/ project/ activity which address the stated problem related to civil engineering.
- There should be team/group of maximum four students.
- A supervisor / mentor faculty teacher assigned to individual groups.

Selection of Project/Problem:

At start of course revision of PBL, significance, guidelines and evaluation parameters should be discussed commonly at start of semester. In this session basics PBL, in brief research methodology points relevant to PBL, sample case studies related to civil engineering and brief information about patent, copy right and publications should be given.

Selection of project/problem related to any technical aspect of civil engineering is recommendedor if any project/problem selected in first year engineering related to civil engineering can be continued if enough potential is there. Give preference to select project/problem related to solving any problem/ issue for which suitable model can be developed or software can be used. The project/problem selected could have different alternative solutions which could be theoretical, practical, working model, demonstration or software analysis. The project/problem selected may have multi-disciplinary approach to get the solution. Problem needs to refer back to a particular practical, scientific, or technical domain. It is recommended to include hands-on activities, organizational and field visits, expert consultation to make students aware with current use of technologies. Proper representation of project/problem, course work and report on the results and conclusion is important for assessment of course.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both students' performance and program effectiveness. Progress and review of PBL is monitored regularly on weekly basis. It is recommended to appoint one teaching faculty as a mentor per group/ batch and it will be duty of mentor to perform monitoring and continuous assessment of individual students as well as entire group for their performance. College/ Department is required to provide necessary assistance. It is the responsibility of students to follow guidelines of their group mentor, maintain self-discipline, authentic collaboration, peer learning and personal responsibility, motivation and adopt interactive learning environment. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes. Intermittent review and assessment of each group should be done after six weeks from the start of the semester. Each group has to submit their work at end of semester during the end review. Group may demonstrate their knowledge and skills through presentation by developing a model/product/poster and report. Individual assessment for each student (Understanding individual capacity, role and involvement in the project). Group assessment (roles defined, distribution of work, intra-team communication and togetherness).

Evaluation and Continuous Assessment:

Prepare "**PBL Log Book**" which includes record of activities performed and evaluation carried out with appropriate remarks. Maintain regular record on weekly basis. Records and documents must also be maintained at student level. Continuous assessment sheet must be prepared by each faculty

which consists assessment made on weekly basis also performance made during mid-review and end-review. PBL log book must be maintained as a record even after completion of semester. It will serve as document which will reflect the punctuality, accountability, technical writing ability and project workflow.

Recommended parameters for assessment, evaluation and weightage:

Evaluation criteria and respective percentage weightage for marks.

1. Idea Inception = 5%
2. Solution provided/ final product at end of course = 50% (Individual assessment and team assessment).
3. Documentation in the form of PBL report (typed, hard copy) = 15%
4. Presentation/ Demonstration of model/ PPT/ poster = 10%
5. Participation/ involvement in group activity =10%
6. Publication/ participation on technical platform = 10%

Course assessment rubrics can be prepared based on the given evaluation parameters for excellent, moderate, acceptable and not acceptable.

References:

1. M. Savin-Baden and C. Howell Major, Foundations of Problem-based Learning. McGraw-Hill Education, 2004
2. T. J. Newby, D. A. Stepich, J. D. Lehman and J. D. Russell, Instructional technology for teaching and learning: Designing instruction, integrating computers, and using media. Englewood Cliffs, NJ: Merrill/Prentice-Hall, 1996
3. S. N. Alessi and S. R. Trollip, Multimedia for learning: methods and development. Needham Heights, MA: Allyn& Bacon, 2001
4. Guerra, Aida, Ulseth, Ronald, Kolmos, Anette, PBL in Engineering Education: International Perspectives on Curriculum Change, Springer, 2017
5. MahnazMoallemWoei Hung Nada Dabbagh, The Wiley Handbook of Problem-Based Learning, Wiley, 2019
6. Jane I. Krauss, Suzanne K. Boss, Thinking Through Project-Based Learning: Guiding Deeper Inquiry.
7. John Larmer, David Ross, John R. Mergendollar, Project Based Learning (PBL) Starter Kit.
8. William N. Bender, Project-Based Learning: Differentiating Instruction for the 21st Century.
9. Bob Lenz, Justin Wells, Sally Kingston, Transforming Schools Using Project-Based Learning, Performance Assessment, and Common Core Standards.
10. Suzie Boss with John Larmer (ASCD/Buck Institute for Education), Implementing Project-Based Learning Solutions by Suzie Boss

Website for references

1. www.pblwork.org
2. www.my.pblworks.org
3. www.swayam.gov.in/nd2_ntr20_ed12/preview
4. www.schoology.com

Format of PBL report: Sequence of pages:

i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Synopsis v) Contents vi) List of

Figures vii) List of Tables vii) Notations

Chapter 1 Introduction (This consists of: 1.1 Introduction of the Project Work; 1.2 Problem Statement, 1.3 Objectives and 1.4 Scope of the Project Works, 1.5 Research Methodology, 1.6 Limitations of study, 1.7 Expected outcome.

Chapter 2 Literature Review (It shall include theoretical support, details regarding work done by various persons, methods established, any new approach.

Chapter 3 Planning Schedule/ Flow Chart for Completion of Project

Chapter 4 Conclusion

References and Bibliography (The references and bibliography shall include name of author/code/manual/book, title of paper/code/manual/book, name of the journal, month & year of publication, volume number/ISBN number, page number x-y. The references and bibliography shall be as per universal standards as mentioned in any international journal of professional body).

Report Printing details:

1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on **Both** sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Savitribai Phule Pune University, Pune Second Year Civil Engineering (2019 Pattern)

201018 Disaster Management

Audit Course II

Teaching Scheme:

Practical: 01 hrs/week

(Certificate to be issued by institute based on performance assessment)

Objectives of the Course:

1. To provide basic conceptual understanding of disasters.
2. To understand approaches of Disaster Management
3. To build skills to respond to disaster

Unit: I

Definition and types of disaster Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires

Unit: II

Study of Important disasters Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters

Unit: III

Mitigation and Management techniques of Disaster Basic principles of disasters management, Disaster Management cycle, Disaster management policy, National and State Bodies for Disaster Management, Early Warming Systems, building design and construction in highly seismic zones, retrofitting of buildings.

Unit: IV

Training, awareness program and project on disaster management Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management, Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

Text Books:

1. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012)
2. Damon, P. Copola, (2006) Introduction to International Disaster Management, Butterworth Heineman.
3. Gupta A.K., Niar S.S and Chatterjee S. (2013)
4. Disaster management and Risk Reduction, Role of Environmental Knowledge, Narosa Publishing House, Delhi.
5. Murthy D.B.N. (2012) Disaster Management, Deep and Deep Publication PVT. Ltd. New Delhi.
6. Modh S. (2010) Managing Natural Disasters, Mac Millan publishers India LTD.

Guidelines for Conduction (Any one or more of following but not limited to)

1. Guest Lectures.
2. Visits and reports.
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

Syllabus for TE Civil Engineering (2019 Pattern)

Implemented from Academic year 2021-22

Board of Studies in Civil Engineering

Faculty of Science and Technology

Savitribai Phule Pune University, Pune TE (Civil Engineering) 2019 Pattern (With effect from Academic Year 2021-22)																	
SEMESTER: V																	
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**						
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
301001	Hydrology and Water Resources Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301002	Water Supply Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301003	Design of Steel Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301004	Engineering Economics and Financial Management	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301005	Elective I	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
301006	Seminar	--	--	01	--	-	50	--	--	50	--	--	--	--	01	01
301007	Hydrology and Water Resources Engineering **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301008	Water Supply Engineering **Lab**	--	02	--	--	--	--	50	--	50	--	--	01	--	--	01
301009	Design of Steel Structures **Lab**	--	04	--	--	--	--	--	50	50	--	--	--	02	--	02
301010	Elective I **Lab**	--	02	--	--	--	25	--	--	25	--	01	--	--	--	01
301011	Audit Course I: Professional Ethics and Etiquettes/ Sustainable Energy Systems	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**15**	**10**	**02**	**150**	**350**	**100**	**50**	**50**	**700**	**15**	**02**	**01**	**02**	**01**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade																	

Elective I: 301005

S N	Course Code	Course Name
01	301005 a	Advanced Fluid Mechanics and Hydraulic Machines
02	301005 b	Research Methodology and IPR
03	301005 c	Construction Management
04	301005 d	Advanced Concrete Technology
05	301005 e	Matrix Methods of Structural Analysis
06	301005 f	Advanced Mechanics of Structures

SEMESTER-VI																	
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
301012	Waste Water Engineering	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301013	Design of RC Structures	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301014	Remote Sensing and GIS	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301015	Elective II	03	--	--	30	70	--	--	--	100	03	--	--		--	03
301016	Internship	--	--	--	--	--	100	--	--	100	--	04	--	--		04
301017	Waste Water Engineering **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
301018	Design of RC Structures **Lab**	--	04	--	--	--	--	--	50	50	--		--	02	--	02
301019	Remote Sensing and GIS **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301020	Elective II **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
301021	Audit Course II: Leadership and Personality Development/ Industrial Safety	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**10**	**01**	**120**	**280**	**200**	**--**	**100**	**700**	**12**	**06**	**--**	**03**	**--**	**21**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																	

Elective II: 301015

S N	Course Code	Course Name
01	301015 a	Advanced Engineering Geology with Rock Mechanics
02	301015 b	Soft Computing Techniques
03	301015 c	Advanced Surveying
04	301015 d	Advanced Geotechnical Engineering
05	301015 e	Architecture and Town Planning
06	301015 f	Solid Waste Management

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.

Unit II: Run Off (06 Hours)

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).

Unit III: Floods (06 Hours)

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)**.**

Unit IV: Reservoir Planning (06 Hours)

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 aeration 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 a: Elective I: Advanced Fluid Mechanics and Hydraulic Machines

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

Pre-requisites
Basic knowledge of Engineering Mechanics, Engineering Mathematics and Fluid Mechanics

Course objectives
01 To study flow over notches and weirs; and the concept of hydraulic jump and losses
02 To state the importance of ideal fluid flow analysis.
03 To study laminar flow between parallel plates.
04 To study unsteady flow through orifice and the concept of water hammer in pipe flow
05 To study impact of free jet on stationary and moving flat and curved vanes
06 To study Pelton wheel, Francis turbine and centrifugal pump from view point of their working principle, work done, efficiency and performance characteristics.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Determine discharge using notches and weirs, and energy loss in hydraulic jump in open channel flow.
02 Describe simple superpositions of basic ideal fluid flows; and determine velocity and shear stress distribution for laminar flow between parallel plates.
03 Understand flow through openings under varying head, and determine rise in pressure due to water hammer effect in pipe flow.
04 Calculate force exerted by free jet on stationary and moving, flat and curved vanes using impulse momentum principle.
05 Design Pelton wheel and Francis turbines and predict their performance characteristics.
06 Estimate performance characteristics of Centrifugal pump

Course Contents

Unit I: Flow Over Notches and Weirs (06 Hours)
Classification of notches and weirs, flow over sharp crested rectangular weir/notch, Francis formula, ventilation of weirs, flow over triangular weir/notch, flow over trapezoidal weir/notch, Cipolletti weir, effect on discharge due to error in measurement of head, broad crested weir, submerged weir, proportional weir or sutro weir. Hydraulic Jump: Assumptions in the theory of hydraulic jump, application of momentum equation to hydraulic jump in rectangular channel: Conjugate depths and relations between conjugate depths. Energy dissipation in hydraulic jump, classification of hydraulic jump and its applications

Unit II: Laminar Flow and Hydraulics for High Rise Buildings (06 Hours)

Laminar flow between parallel plates: plates at rest, one plate moving and other at rest (Couette flow), laminar flow through porous media. Introduction of high-rise building, importance and significance of plumbing design, list of components in high rise plumbing, provisions for pressure, velocity and discharge as per uniform plumbing code-India (UPC-I), water supply fixture unit (WSFU) and peak water demand of plumbing fixtures, drainage fixture unit (DFU), maximum loads for horizontal fixture branches and building drains or sewers.

Unit III: Unsteady Flow (06 Hours)

Introduction to flow through sharp crested circular orifice under constant head, types of unsteady flow, flow through openings under varying head, fluid compressibility, celerity of elastic pressure wave through fluid medium. Water hammer phenomenon, rise of pressure due to water hammer, surge tanks and its function

Unit IV: Impact of Free Jets (06 Hours)

Impulse momentum equation, force exerted by jet on stationary and moving flat plate (normal & inclined to the jet), flat plates mounted on periphery of a wheel, force exerted by jet on symmetrical stationary curved vane at centre, on unsymmetrical stationary curved vane tangentially at one of the tips. Force exerted by jet on symmetrical moving curved vane at the centre, symmetrical curved vanes mounted on periphery of a wheel, force exerted by jet on unsymmetrical moving curved vane tangentially at one of the tips, torque exerted on a wheel with radial curved vanes.

Unit V: Hydraulic Turbines (06 Hours)

Elements of hydroelectric power plants, heads and efficiencies and classification of turbines Pelton wheel turbine: component parts and its working, work done and efficiencies, working proportions, design, multiple jet Pelton wheel (introduction). Francis turbine: component parts and its working, work done and efficiencies, working proportions, design, draft tube theory, cavitation in hydraulic turbines, governing of turbines. Performance of turbine, prediction of performance in terms of unit quantities and specific quantities, specific speed, characteristic curves, model testing of turbines, selection of turbines

Unit VI: Centrifugal Pumps (06 Hours)

Component parts, working, types of centrifugal pumps, work done by impeller, head of pump, losses and efficiencies, minimum starting speed, loss of head due to increased or reduced flow, diameters of impeller and pipes, pumps in series and parallel, suction lift, net positive suction head, cavitation in centrifugal pump, introduction to submersible pumps. Performance centrifugal pump: characteristic curves, specific speed, model testing.

Text Books

01 Hydraulics and Fluid Mechanics including Hydraulics Machines, Dr. P. N. Modi and Dr. S. N. Seth, Standard Book House, Maw Delhi

02 Engineering Fluid Mechanics, Prof. K. L. Kumar, S. Chand & Company Ltd

03 Flow in Open Channels, K Subranmanya, McGraw Hill Education
04 A Text Book of Fluid Mechanics and Hydraulic Machines, Dr. R K Rajput, S Chand and Co Ltd, New Delhi

Reference Books

01 Engineering Fluid Mechanics, Garde and Mirajgaonkar, Scitech
02 A Text Book on Fluid Mechanics and Hydraulic Machines, Sukumar Pati, McGraw Hill, New Delhi
03 A Text Book of Fluid Mechanics and Hydraulic Machines, R K Bansal, Laxmi Publications Pvt. Ltd., New Delhi
04 Fluid Mechanics, Fundamentals and Applications, Yunus A Cengel and John Cimbala, McGraw Hill International, New Delhi
05 Fluid Mechanics by Frank M White, McGraw Hill
06 Fluid Mechanics by Streeter, Wylie and Bedford, McGraw Hill International, New Delhi

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 b: Elective I: Research Methodology and IPR

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

Prerequisite
Project based learning, Fundamental of Civil Engineering, Soft and Communication Skills.

Course Objectives
01 The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
02 It will create consciousness of research methodology, which will be useful to develop a research culture in the young minds.
03 Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand a research problem for civil engineering domain.
02 Analyze the available literature for given research problem and illustrate different techniques of literature survey thereby gap identification.
03 Recognize the importance of data collection and investigate the statistical and reliability methods of preliminary data analysis.
04 Explain the important concept of interpretation and develop technical writing and presentation skills.
05 Comprehend the various forms of the intellectual property, its relevance and business impact in the changing global business environment.
06 Realize the importance of patents, trademark and copyright and follow research ethics.

Course Contents

Unit I: Introduction to Research (06 Hours)
Introduction, meaning of research, objectives of research, types of research, research approaches, significance of research, research methods versus methodology, research and scientific method, research process, criteria of good research, problems encountered in India for good research, formulation of research hypotheses, search for causation, format for research proposal, funding for the proposal, different funding agencies, and framework for the planning.

Unit II: Literature Survey (06 Hours)
Definition of literature and literature survey, significance of literature survey, sources of literature, elements and objectives of literature survey, styles of literature survey, strategies of literature survey, searching the existing literature, reviewing the selected literature, writing

about the literature reviewed and gap identified. Techniques to frame the objectives and define the problem statement

Unit III: Data Collection and Preliminary Data Analysis (06 Hours)

Classification of research data, benefits and drawbacks of research data, collection of primary data, collection of secondary data, selection of appropriate method for data collection, evaluation of data, any case study method. Testing of hypothesis- concepts and testing, review of theory of reliability, hazard models, system reliability. data presentation skills, features of statistical analysis, histogram, bar charts, Pie charts, 2D & 3D plots, interpolation & extrapolation techniques, curve fitting.

Unit IV: Interpretation and Report Writing (06 Hours)

Meaning of interpretation, need of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, mechanics of writing a research report, precautions for writing research reports, plagiarism, research ethics, tools for technical writing and presentation, conclusions

Unit V: Intellectual Property Rights (06 Hours)

Introduction and significance of intellectual property rights, types of intellectual property rights, copyright and its significance, introduction to patents and its filing, introduction to patent drafting, best practices in national and international patent filing, copyrightable work examples. Initiatives of government and private organization to promote research activities in education sector

Unit VI: Patent Rights (06 Hours)

Patents and its basics, patentable items, designs, process of filing patent at national and international level, process of patenting and development, technological research and patents, innovation, patent and copyright international intellectual property, procedure for grants of patents, need of specifications, types of patent applications, provisional and complete specification, patent specifications and its contents, trade and copyright.

Text books

01 Research Methodology Methods & Techniques, C. K. Kothari, 2nd edition, New Age International, New Delhi.

02 Intellectual Property Rights-Law in India, Ramappa, 2nd edition, Asia Law House, Hyderabad.

Reference Books

01 Research Methods in Education, Louis Cohen, Manion, Morrison and Routledge, 8th edition, Taylor & Francis Group- Cambridge University Press India Pvt. Ltd

02 Research in Education, John Best and James Kahn, 8th edition, Prentice Hall of India Pvt. Ltd.

03 Research Methodology: An Introduction for Science and Engineering Students, Stuart Melville and Wayne Goddard, Juta & Co Ltd

04 Research Methodology: A Step by Step Guide for beginners, Ranjit Kumar, 2nd edition, Pearson Education.
05 Resisting Intellectual Property, Halbert D J, 2nd edition, Taylor and Francis Ltd.
06 Intellectual Property in New Technological Age, Robert P. Merges, Peter S. Menell and Mark A. Lemley, Stanford Public Law Working Paper No. 2780190, Elsevier Publishers.

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
301005 e: Elective I: Matrix Methods of Structural Analysis

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

Pre-requisites
Fundamentals of Mathematics, Engineering Mechanics and Structural Analysis

Course objectives
01 To understand the structural behavior of beams, plane frames by analyzing using flexibility method of analysis.
02 To generate element/member stiffness matrix, transformation matrix and global/structure stiffness matrix for the skeletal structures and analyze the structure using stiffness method.
03 To develop program algorithm/flowcharts applying the concepts of member approach of stiffness method to analyze skeletal structures and forming base for the study of Finite element method

Course outcomes
On successful completion of this course, the learner will be able to:
01 To understand the structural behavior of bars and trusses and analyze it by using flexibility method of analysis.
02 To understand the structural behavior of beams and plane frames and analyze it by using flexibility method of analysis.
03 To analyze bars, springs and truss by member approach of stiffness matrix method.
04 To analyze beams by member approach of stiffness matrix method and to develop transformation matrix and global/structure stiffness matrix for plane frame and thereby analyze it by member approach of stiffness matrix method.
05 To develop transformation matrix and global/structure stiffness matrix for grid and analyze the grid by structure and member approach of stiffness matrix method.
06 To develop the member stiffness matrix of space truss and space frame and develop the flow chart /algorithm to write the program for analysis of skeletal structures with reference to computer application.

Course Contents

Unit I: Analysis of Trusses and Bars by Flexibility Method (06 Hours)
Review of degree of static indeterminacy for bars and trusses, basic concept of flexibility, flexibility coefficients, selection of redundant, generation of flexibility matrix, analysis of bars and spring assembly and trusses involving not more than two unknowns.

Unit II: Analysis of Beams and Rigid Joined Frame by Flexibility Method (06 Hours)
Review of degree of static indeterminacy for beams and frame, selection of redundant, generation of flexibility matrix, analysis of beams and simple portal frames involving not more than two unknowns.

Unit III: Analysis of Trusses and Bars by Stiffness Method (06 Hours)
Review of degrees of freedom for bars and trusses, basic concept of stiffness, stiffness coefficients, local and global coordinate systems, generation of member stiffness matrix for an axially loaded bar members, formation of overall stiffness matrix, analysis of axially loaded bars, springs by member approach not involving more than three unknowns. Formation of the member stiffness matrices of a truss member considering two degrees of freedom at each node, formation of overall stiffness matrix, analysis of trusses by member approach involving not more than three unknowns

Unit IV: Analysis of Beams and Rigid Joined Frame by Stiffness Method (06 Hours)
Review of degrees of freedom for beam and rigid jointed frames, generation of member stiffness matrix for beam, formation of overall stiffness matrix, load vector, analysis of beams by member approach up to maximum three unknown. Generation of local member stiffness matrix for frame, concept of transformation matrix, formation of transformation matrix for frame member, formation of global member stiffness matrix, analysis of frame by member approach up to maximum three unknown.

Unit V: Analysis of Grid by Stiffness Method (06 Hours)
Review of degrees of freedom for grid member, stiffness matrix method using structure approach for analysis of orthogonal grid structure, member approach: generation of local member stiffness matrix for grid and derivation of transformation matrix for grid member, problems involving not more than three unknowns by structure approach.

Unit VI: 3-D Skeletal Structures and Flowchart for Stiffness Method (06 Hours)
Review of degrees of freedom for space truss and frame, local member stiffness matrix, transformation matrix for space truss member, formation of local member stiffness matrix of space frame element, computer algorithm and flowcharts for generating the element/member, transformation and global/structure stiffness matrices for bars, plane truss, plane frame and grid.

Text Books

01 Structural Analysis - A Matrix Approach, Pandit G S and Gupta S P, Tata McGraw Hill
02 Matrix Methods of Structural Analysis, Meghare and Deshmukh, Charotar Publishing House, Anand.

Reference Books

01 Matrix Analysis of Framed Structures by Weaver W and Gere G M, CBS Publisher, Delhi.

02 Matrix methods of structural analysis, C. K. Wang, International Textbook Co; 2nd edition.

03 Advanced Structural Analysis, Devdas Menon, Narosa Publication.

04 Matrix Methods of Structural Analysis: Theory and Problems, C. Natarajan and P. Revathi, Prentice Hall India Learning Private Limited

05 Matrix Methods of Structural Analysis, Bhavikatti S S, I K international Publishing house

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301005 f: Elective I: Advanced Mechanics of Structures

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

Pre-requisites
Fundamental of Engineering Mechanics and Mechanics of Structures

Course objectives
01 To learn the concept of moment area and conjugate beam method to find slope and deflection
02 To study different type of stresses in thin and thick cylindrical shells
03 To learn application of influence line diagram to find the forces in the members due to moving load
04 To study the analysis of beams and arches

Course outcomes
On successful completion of this course, the learner will be able to:
01 Apply moment area and conjugate method to find slope and deflection.
02 Evaluate stresses and strain in thin and thick cylinder.
03 Analyze the beam and trusses by influence line diagram.
04 Analyze the beam for moving load by influence line diagram.
05 Understand and analyze beam curved in plan and elevation.
06 Analyze three and two hinged arches for axial thrust, shear and moment.

Course Contents

Unit I: Slope-Deflection by Moment Area and Conjugate Beam Methods (06 Hours)
Moment area method: basic concept, M/EI diagram, slope and deflection of cantilever subjected to moment, point load and uniformly distributed load. Conjugate beam method: basic concept, slope and deflection of beams subjected to moment, point load and uniformly distributed load.

Unit II: Thin and Thick Cylinders (06 Hours)
Thin cylinders: basic concept, circumferential, longitudinal and shear stresses, circumferential, longitudinal and volumetric strain, effect of compressible and non compressible fluid injected under pressure. Thick cylinders: basic concept, thick cylinder subjected to internal and external pressure, derivation of Lame's equation for radial and circumferential stresses, representation of radial and circumferential stresses.

Unit III: Influence Line Diagrams (06 Hours)
Influence line diagram for beams: introduction, influence line diagram for reaction, shear and moment for simple beam, influence line diagram for girder and compound beam and application of influence line diagram. Influence line diagram for trusses: bridge floor system,

influence line diagram for truss reaction, member forces, determination of maximum forces and influence line diagram for non parallel chord members.

Unit IV: Rolling Loads (06 Hours)

Introduction, maximum shear force and bending moment at any section of beam subjected to uniformly distributed and two point load. Maximum end shear force, shear force at section, bending moment at section and absolute maximum moment, equivalent uniformly distributed load.

Unit V: Beams Curved in Plan and Elevation (06 Hours)

Beams curved in plan: Introduction, circular beam loaded with uniformly and supported on symmetrically placed column, simply supported semi circular beam supported on three supported equally spaced, quarter circle beam fixed at one end and free at other end carrying point load at free end. Beams curved in elevation: Introduction, assumptions, expression for flexural stresses in curved beam/ Winkler-Bach theory, different cross section for curved beam

Unit VI: Three and Two Hinged Arches (06 Hours)

Three hinged arches: basic concept, linear arch, bending moment: Eddy's theorem, analysis of three hinged circular and parabolic arch subjected to uniformly distributed, Influence line diagram for axial thrust, shear and moment of three hinge arches. Two hinged arches: basic concept, analysis of two hinged circular and parabolic arch subjected to uniformly distributed and point loads respectively considering supports at same level.

Text Books

01 Analysis of Structure, Vol II, V N Vazirani, M M Ratwani and S K Duggal, Sixteenth Edition, Khanna Publisher, Delhi

02 Mechanics of Structures, Vol. I & II, S B Junnarkar and H J Shah, Twenty Fourth Editions, Charotar Publishing House, Pvt Ltd, Anand

Reference Books

01 Strength of Materials, Stephen Timoshenko, Third Edition, CBS Publisher & distributer, New Delhi

02 Theory of Structures Vol I, G S Pandit, S P Gupta and R Gupta, McGraw Hill Education (India) Pvt Ltd, New Delhi

03 Fundamentals of Structural Analysis, Kenneth M Leet, Chia-Ming Uang and Anne M Gilbert, Third edition, McGraw Hill Education (India) Pvt Ltd, New Delhi

04 Strength of materials, Andrew Pytel and Ferdinand L Singer, Fourth edition, Harpercollins College Div

05 Structural Analysis in SI Units, R C Hibbler, Pearson Education

06 Mechanics of Materials, E P Popov, Pearson

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 a: Elective I: Advanced Fluid Mechanics and Hydraulic Machines Lab

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

Term Work

Term work consists of following experiments, assignment, and report of site visit. Term work marks will be based on continuous assessment.

List of experiments

01 Calibration of rectangular notch/Triangular notch/spillway Cipolletti weir
02 Analysis/ Visualization of Laminar Flow between two parallel plates using Heleshaw's apparatus
03 Study of Hydraulic Jump as Energy Dissipater in Rectangular Channel
04 Impact of jet on flat plate and curved vane
05 Characteristics of Pelton / Francis turbine
06 Characteristics of Centrifugal pump

Assignments

01 Laminar flow and hydraulics of high rise buildings (Min. 5 questions with minimum 3 numerical problems)
02 Design of Pelton wheel and Francis Turbine
03 Write a computer program to solve any fluid flow problem from above six units; or demonstration of application of any software (e.g. HEC-RAC, MODFLOW, SUTRA, SWMM, EPANET, etc) to solve fluid flow problem based on above six units

Site visit

01 Site visit report on visit to hydroelectric power plant

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 b: Elective I: Research Methodology and IPR Lab

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

Term Work

The term work should consist of following assignments. Term work marks will be based on continuous assessment.

01 Literature review: Collect the existing literatures on any research idea in civil engineering and identify the research gap. (Performed in a group of students of not more than three).

02 Report and seminar presentation: Prepare the research proposal based on the earlier identified research gap (report should be checked for plagiarism) and present the idea. (Performed in a group of students of not more than three).

03 Collection of standard format and guidelines of research proposal: Identify the national and international funding agencies and prepare research proposal for any one of the funding agency (in a group of students of not more than five).

04 Prepare a report on different citation styles and referencing styles adopted by different publishers. (Performed by individual student).

05 Write a report on case study of any existing patent/copy right/trademark. (Performed by individual student).

06 Collect the information of any one referred peer reviewed journal and write a report based on abstracting and indexing, H Index, SJR rating, impact factor, aim and scope of the journal, guidelines for paper submission etc. (Performed by individual student).

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

Teaching scheme	**Credit**	**Examination scheme**
Practical: 02 Hours/week	01	Term Work: 25 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: 25 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
301010 e: Elective I: Matrix Methods of Structural Analysis Lab

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

Term Work

Term work consists of following assignments. Every student should have different set of assignments/problems/data on each unit covering all the topics. Term work marks will be based on continuous assessment.

01 **Assignment 1 to 6:** minimum five numerical from each unit.

OR

If available, students can attend any equivalent/similar course on SWAYAM/AICTE/NPTEL/any government technical education site; and solve its assignments.

02 **Assignment 7:** Write computer programs to analyze any two skeletal structures using any programming language.

03 **Assignment 8:** Analyze any two structures from different units using any suitable software.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 f: Elective I: Advanced Mechanics of Structures Lab

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

Term Work

The term work should consist of following assignments and site visit. Term work marks will be based on continuous assessment.

S N	Contents of term work
01	**Assignment I:** Minimum four numerical to find slope and deflection of beams with varying flexural rigidity by moment area and conjugate beam method.
02	**Assignment II:** Minimum four numerical on thick and thin cylinder with graphical presentation of stresses.
03	**Assignment III:** Minimum four numerical with influence line diagram for simple beam, compound beam, chord member and web member of truss.
04	**Assignment IV:** Minimum four numerical to find maximum shear force and bending moment for two point load, uniformly distributed load smaller than span, uniformly distributed load larger than span and to find equivalent uniformly distributed load.
05	**Assignment V:** Minimum two numerical to find bending stress for beam curved in elevation and two numerical to find maximum shear force and bending moment for the beam curved in plan.
06	**Assignment VI:** Minimum two numerical to analyze three hinged circular and parabolic arch and two numerical to analyze two hinged circular and parabolic arch.
07	**Site visit:** Compulsory site visit for cylinder/curved beams/arches.

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

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

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
301015 b: Elective II: Soft Computing Techniques

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 Mathematics

Course objectives
01 To make students aware about soft computing techniques
02 To impart knowledge about components and training of ANN
03 To introduce students to important aspects of neural network design
04 To introduce students to neural network types and its application
05 To impart knowledge about working of genetic algorithms and Support vector regressions along with their applications
06 To impart knowledge about working of model tree and random forest along with their applications

Course outcomes
On successful completion of this course, the learner will be able to:
01 Understand AI techniques, soft computing techniques and basic concepts Artificial Neural Network
02 Understand components of ANN, training algorithms and implement the back propagation algorithm
03 Design the feed forward back propagation neural network.
04 Understand types of neural networks and their applications
05 Understand working of genetic algorithm, support vector regressions, model tree and random forest along with their applications
06 Develop models for time series applications using support vector regressions, model tree and random forest.

Course Contents

Unit I: Artificial Neural Networks (06 Hours)
Introduction: hard computing and soft computing, introduction to artificial intelligence (AI) and soft computing, soft computing and data driven techniques, biological neural network, artificial neuron, ANN history and general properties, ANN types according to architecture and neuro-dynamics, ANN Vs empirical, statistical, physical, physics-based models.

Unit II: Components of Neural Network and Training (6 hours)
Components of artificial neuron, methods of computing net information, activation functions (linear, sigmoidal, hyperbolic tangent, hard limiter, soft-lin), perceptron, multi-layered perceptron (MLP), pre-training procedures: data normalization, network initialization, types

of training: supervised and un-supervised, network training using supervised training algorithms: standard back propagation algorithm and preliminary information of other algorithms like gradient descent, conjugate gradient, resilient back propagation, Broydan-Fletcher-Goldfarb-Shanno algorithm, one step secant algorithm, Levernberg-Marquardt algorithm.

Unit III: Important Aspects of Neural Network Design (06 Hours)

Important aspects of artificial network design as network architecture, inputs, outputs, number of hidden layers, number of hidden neurons, stopping criteria, overfitting, validation, testing, normalization and de-normalization, evaluating model performance, data division, performance function, design a FFBP neural network with a short numerical.

Unit IV: Types of Neural networks and it's Applications (06 Hours)

Recurrent networks, radial basis function networks, generalized regression neural networks, self-organizing maps (discuss using case studies of each referring to published papers and literature), design of artificial neural network for time series (univariate and multivariate) and cause-effect applications.

Unit V: Genetic Algorithm and Support Vector Regression (06 Hours)

Introduction to genetic algorithm, genetic operators along with different parameters, applications of GA in civil engineering, introduction to support vector machines, support vector regression, basics of SVR, application of SVR in temporal and cause effect modeling in civil engineering, design of SVR model for time series applications.

Unit VI: Model Tree and Random Forest (06 Hours)

Introduction to model tree: M5 Algorithm, basics of MT and application of MT in temporal and cause effect modeling, design of MT model for time series applications, introduction to random forest, basics of RF and application of RF in civil engineering, design of RF model for time series applications.

Text Books

01 Soft Computing in Water Resources Engineering: Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms, Tayfur G., WIT Press.

02 Neural Network Fundamentals with Graphs, Algorithms and Applications, Bose, N. K. and Liang, P., Tata McGraw-Hill Publication.

03 Decision Trees and Random Forests: A Visual Introduction for Beginners: A Simple Guide to Machine Learning with Decision Trees, Chris S, and Mark K., Blue Windmill Media

04 Genetic Algorithm in search, Optimization and Machine learning, Goldberg, D., Addison Wesley Publishing Company.

Reference Books

01 Neural Networks and Fuzzy systems, Kosko B, Prentice Hall, Englewood Cliffs.

02 Advanced methods in neural computing, Wasserman, P D, Van Nostrand Reinhold

03 Publications in peer reviewed international unpaid journals.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 c: Elective II: Advanced Surveying

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 Mathematics and Surveying

Course objectives
01 To understand the advance surveying techniques and instruments.
02 To interpret the advanced surveying measurements.
03 To execute the ground as well as aerial mapping.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Recognize the concept of triangulation for fixing the ground control points.
02 Differentiate most probable values for different measurement and adjust those in a given figure.
03 Summarize the concepts of astronomical and hydrographic surveying.
04 Demonstrate the use of aerial photographs for mapping.
05 Analyze use of modern surveying instruments in the field.
06 Execute GPS and the associated software for different applications in civil engineering.

Course Contents

Unit I: Geodetic Surveying and Trigonometric Leveling (06 Hours)
Geodetic surveying: objectives and methods of geodetic surveying, concept of triangulation, triangulation figures, classification of triangulation survey, concept of well conditioned triangle, selection of stations, inter visibility and height of stations, field work in triangulation, concept satellite station. Trigonometric leveling:-terrestrial refraction, angular corrections for curvature and refraction, axis signal correction, determination of difference in elevation by single observation and reciprocal observations.

Unit II: Theory of Errors and Triangulation Adjustment (06 Hours)
Types of errors, definitions, laws of accidental errors, laws of weights, determination of the most probable values of quantities, theory of least squares, method of normal equations, method of corrections, method of correlates, rules for giving weights and distribution of errors to the field observations. Angle and station adjustment, figure adjustment, adjustment of geodetic quadrilateral, spherical triangle and calculations of spherical excess and sides of spherical triangle.

Unit III: Astronomical and Hydrographic Survey (06 Hours)

Astronomical surveying: definitions of astronomical terms, coordinate systems for locating heavenly bodies, geographic, geodetic, geocentric, Cartesian, local and projected coordinates for earth resources mapping, elements of spherical trigonometry, shortest distance between two points on earth, determination of latitude and longitude, determination of azimuth. Hydrographic surveying: objectives of hydrographic survey, shore line and river survey, soundings: equipments to measure sounding, methods to locate sounding, three-point problem and its solution (analytical, mechanical and graphical), determination of MSL using GPS.

Unit IV: Aerial Photogrammetry (06 Hours)

Introduction, principle, uses, classification-qualitative and quantitative photogrammetry, types of aerial photographs, definitions, scale of vertical photograph, ground co-ordinates, relief displacement, parallax bar, height from parallax measurements, mirror stereoscope, flight planning, procedure of aerial survey, photomaps and mosaics, digital photogrammetry, drone mapping and photogrammetry.

Unit V: Modern Surveying Instruments and Techniques (06 Hours)

Introduction to remote sensing, active and passive remote sensing, developments of remote sensing technology and advantages, different platforms of remote sensing, EM spectrum, interaction of EM radiation with atmosphere, remote sensing applications in flood mapping, definition of GIS, components of GIS, importance of GIS, raster data and vector data, primary and secondary data, applications of GIS. Total station: classification, fundamental quantities measured, parts and accessories, basic measuring and working principle of total station, field procedure for total station survey, sources of errors in total station, care and maintenance of total station, basic principles of electronic distance measuring instrument, reflector-less total station, robotic total station, smart station, LIDAR and GPR.

Unit-VI: GPS Surveying (06 Hours)

Geodesy fundamentals, geoid, datum, ellipsoid: definition and basic concepts, coordinate systems, special referencing system, map scale, scale factors, Indian geodetic system, reference surface, geodetic systems, segments of GPS, GPS codes, types of GPS receivers, principle of GPS positioning, GPS data formats. GPS errors sources and GPS accuracy, GPS survey methods, future developments in GPS, DGPS and RTK technique, GPS applications and limitations, advantages of GPS surveying over conventional methods, digital terrain model (DTM): topographic representation of the terrain and generation of DTM on computers using spot heights and contour maps.

Text Books

01 Surveying and Leveling - Part-II and III, T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan, Pune.

02 Surveying Vol. II, S.K. Duggal, Tata McGraw Hill Publishing Company Ltd. New Delhi.

Reference Books

01 Advanced Surveying: Total Station, GPS, GIS & Remote Sensing, Satheesh Gopi, 2/e, Pearson Education, Chennai.

02 Surveying Vol. II & III, B C Punmia, Laxmi Publications, New Delhi.

03 Surveying Vol. II & III, K R Arora, Standard book house, New Delhi.

04 Surveying and Leveling, R Subramanian, Second edition, Oxford University Press, New Delhi.

05 Remote Sensing and Geographical Information Systems, Anji Reddy, BS Publications, Hyderabad.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 d: Elective II: Advanced Geotechnical 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 Engineering Mechanics, Fluid Mechanics and Geotechnical Engineering

Course objectives
01 To learn the classification of soil, soil structure, role of water in clay, earth pressure on retaining structures and the design of retaining structures.
02 To study types of triaxial tests and draw the stress paths.
03 To know methods to implement soil stabilization and different ground improvement techniques

Course outcomes
On successful completion of this course, the learner will be able to:
01 Classify the soil and understand the soil structure and role of water in clay.
02 Calculate lateral pressure on retaining structures and carry out design the retaining structures.
03 Interpret the results of triaxial tests under different drainage conditions.
04 Draw the stress paths for different conditions.
05 Select and implement soil stabilization techniques based on field conditions.
06 Explain different ground improvement techniques.

Course Contents

Unit I: Soil Classification, Soil Structure and Clay Minerals (06 Hours)
Soil identification and classification, criteria for classifying soil, classification on the basis of grain size, plasticity, symbolic and graphic presentation, classified soils and engineering properties, USCS, BIS, AASHTO and textural classification systems. Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II: Earth Pressure Theory and Design of Earth Retaining Structures (06 Hours)
Types of earth retaining structures, design of gravity and cantilever retaining walls, bracing system and apparent earth pressure diagram for open cuts, only concept of cantilever sheet pile walls and an anchored sheet pile walls, Reinforced earth retaining wall: general principles, concepts and mechanism of reinforced earth , design consideration of reinforced earth: geotextile, geogrids, metal strips and facing elements, construction: selection of type of retaining structures, construction practice, field observations.

Unit III: Shear Strength of Soil **(06 Hours)**

Shear strength of clay soils: undrained strength from UU test, consolidated undrained strength from CU test, consolidated drained strength from CD test, stress strain and volume change relationship. Shear strength of sands: stress strain and volume change relationship, behavior of saturated sand under drained and undrained conditions, factors affecting angle of shearing resistance, pore pressure parameters and determination.

UNIT-IV: Stress Path **(06 Hours)**

Failure lines in stress path, TSP and ESP, stress path for: isotropic consolidation, one dimensional consolidation, unloading of over consolidated clay, sedimentation. Elastic stress path, Stress path for: triaxial drained and triaxial undrained test. Stress path for field conditions: embankment construction, excavation, failure of infinite and finite slope, undrained slope excavation, stress changes below foundation and near retaining wall

Unit V: Soil Stabilization **(06 Hours)**

Soil stabilization: introduction, objectives, factors affecting stabilization of soils, methods of stabilization: mechanical, cement, lime, bituminous; classification of stabilizing agents and stabilization processes. Lime stabilization: base exchange mechanism, pozzolanic reaction, lime-soil interaction, cement stabilization: mechanism, amount, fly-ash: lime stabilization and soil bitumen stabilization.

Unit VI: Ground Improvement **(06 Hours)**

In-situ ground improvement by compaction piles, dynamic loads, explosion sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation without numerical.

Text Books

01 Basic and Applied Soil Mechanics, Gopal Ranjan and A. S. Rao, New Age Publication.
02 Geotechnical Engineering, Shashi K. Gulati and Manoj Datta, Tata Mc-Grawhill.
03 Soil Mechanics and Foundation Engineering, Dr. B. C. Punmia, Laxmi Publications

Reference Books

01 Principles of Geotechnical Engineering, Braj M. Das, Cengage Learning**.**
02 Advance Soil Mechanics, Braja Mohan Das, Tata Mc- Graw Hill
03 Physical and Geotechnical properties of soils, Joseph E. Bowels, Tata Mac-Graw Hill.
04 Engineering Principles of Ground Modification, Monfred R Hausmann, Mc Graw Hill Publishing Co.
05 Foundation Analysis and Design, Joseph E. Bowels, Tata Mc-Graw Hill.
06 Ground Improvement Techniques, P. Purushothama Raj, Laksmi Publications, New Delhi.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 e: Elective II: Architecture and Town Planning

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

Pre-requisites
Fundamentals of Building Technology and Architectural Planning

Course objectives
01 To use principles of architectural planning and understand futuristic need of users.
02 To discuss and demonstrate the concepts of landscaping, urban renewal and sustainable architecture
03 To distinguish and relate planning levels and understand use of act and to develop neighborhood plan
04 To interpret need of civic surveys for DP proposal and value planning agencies and ITS
05 To understand and demonstrate planning strategy with reference to different acts, guidelines, norms.
06 To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning

Course outcomes
On successful completion of this course, the learner will be able to:
01 Apply the principles of architectural planning and landscaping for improving quality of life
02 Understand the confronting issues of the area and apply the acts.
03 Evaluate and defend the proposals.
04 Appraise the existing condition and to develop the area for betterment.

Course Contents

Unit I: Architect and Urban Planning (06 Hours)
Principles and elements of architectural composition and its expected outcome, qualities of architecture: user friendly, contextual, eco-friendly, utility of spaces, future growth etc. with case study. Role of urban planner and an architect in planning and designing in relation with spatial organization, utility, demand of the area and supply etc considering situations like disasters / pandemic conditions.

Unit II: Landscaping (06 Hours)
Landscaping: objectives, principles, elements, material (soft and hard), styles of landscaping, green roofs and vertical gardens: need, means, outcome, urban renewal process and its impact

on quality of life and livability, importance of sustainable architecture, urban conservation with case study.

Unit 3: Town Planning **(06 Hours)**

Scope, purpose and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, new towns and satellite towns, legislative mechanism for preparation of DP: MRTP Act 1966

Unit 4: Civic Survey **(06 Hours)**

Civic surveys and its utility for DP proposal: like demographic, housing, land use, water supply and sanitation. Planning agencies for various levels of planning and the organizational details with purpose (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA and HUDCO), Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems

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

Land acquisition rehabilitation and resettlement Act, 2013, real estate (regulation and development) act 2016 and MAHA-RERA, URDPFI Guidelines (for land use, infrastructure etc.), AMRUT Guidelines (water/sewerage, transport etc.)

Unit 6: Special Township **(06 Hours)**

Special townships: SEZ and CRZ, application of GIS, GPS, remote sensing in Town planning, rural planning: need, strategies, government initiatives

Text Books

01 Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
02 Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books

01 MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai
02 URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India
03 LARR Act 2013: Ministry of law and justice, Government of India
04 Climate Responsive Architecture, Arvind Krishnan, Nick Baker, Simos Yannas and Steve Szokolay, McGraw Hill Education
05 An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301015 f: Elective II: Solid Waste Management

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

Pre-requisites
Fundamentals of Environmental Studies, Engineering Chemistry and Waste Water Engineering

Course objectives
01 To understand problems of solid waste, estimate and characterize the solid waste and apply the knowledge of laws for municipal solid waste management for handling of MSW.
02 To understand government initiatives for management of solid waste, to apply the knowledge of mathematics, science, and engineering for effective solid waste collection systems, for waste collection route optimization and its economics.
03 To understand processing of solid waste, material recovery facility and to design composting systems, maintain and operate composting process for effective organic waste recycling.
04 To understand working of waste to energy system and to design of bio-methnation and incineration system.
05 To design & manage construction and operations of landfill facilities and management of legacy solid waste.
06 To understand management and legal requirements of special waste and reuse, recycle and material recovery from solid waste.

Course outcomes
On successful completion of this course, the learner will be able to:
01 Outline solid waste management systems with respect to its generation rate (quantity), sampling, characteristics and regulatory/legal requirements.
02 Explain and suggest relevant method of storage, collection and transportation of solid waste for the given site condition with justification.
03 Develop understanding of technological applications for processing and material recovery from solid waste with its economics and design composting system for organic waste.
04 Describe the fundamental and technological aspects of waste to energy systems from solid waste and to design anaerobic digester and incineration system.
05 Outline the design, operation, and maintenance of sanitary landfill and management of legacy waste.
06 Explain the functional element for management of special waste and suggest the relevant method of reuse and recycling for the given type of waste in the given situation.

Course Contents

Unit I: Introduction to Solid Waste Management (06 Hours)

Definition, objectives of SWM, impacts of improper SWM: soil, water and air, functional outlines of SWM, sources and types of solid waste. MSW: sampling, refuse analysis, composition, characteristics: physical, chemical, biological and generation rate, factors affecting generation rate, estimation of quantity of solid waste. Sustainable solid waste management for smart cities, role of urban local bodies in waste management, objectives and importance of MSW Rules 2016, rules and regulations of SWM in developed countries.

Unit II: Government Initiatives, Collection & Transportation of Solid Waste (06 Hours)

Swachh survekshan and its impact on the SWM scenario in India, national urban livelihood missions (NULM) and its role in SWM, social entrepreneurship, swachhta & rural engagement cell (SESREC): government of India initiatives, success stories of SWM in India. Integrated solid waste management, storage, different methods of collection, collection systems, transfer and transportation of solid waste, uses of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicles location, optimization of route, measurement and methods of measuring solid waste, economics of solid waste collection and transport.

Unit III: Processing and Transformation of Solid Waste (06 Hours)

Decentralised system Vs centralised system, three tier system, source reduction, segregation and salvage, material recovery facility centres, resource recovery of bye-products, recycling and reuse of solid waste, use of solid waste as raw materials in industry, value added products, recycling and carbon credits, economics of solid waste processing, circular economy in waste management. Theory of composting, processing before composting, types of composting (home composting, vermicomposting, organic waste converter, rotary drum, continuous flow reactor), explain methods: Indore method, Bangalore method, mechanical composting plant, factors governing composting and design of composting system.

Unit IV: Waste to Energy (06 Hours)

Bio-methnation: theory of anaerobic digestion, stages, factors affecting anaerobic digestion, recovery of bio-gas, applications/use of biogas, design of anaerobic digester. Energy content of MSW, estimation of low and high heating value (LHV, HHV), theory and types of incinerators, design of incineration plant. Pyrolysis, refused derived fuel (RDF), plasma gasification: working principle, energy recovery, advantages, limitations and applications, environmental impacts of waste to energy: dioxins, furans, heavy metals etc.

Unit V: Disposal of Solid Waste (06 Hours)

Landfill: Introduction, components of land filling, types of land filling, site selection, acceptable waste, construction techniques, maintenance and precautions, leachate and landfill gas: estimation, management, treatment and disposal/reuse, control of contamination of ground water, operation monitoring, closure and end-use, advantages and disadvantages of secured landfill facility (SLF), design of sanitary landfill, slope stability analysis, concept of

bioreactor landfill: principle, types, applications. Legacy waste management or biomining: concept, methods, applications, economics and time duration.

Unit VI: Special Waste Management and Regulations (06 Hours)

Sources, collection, transportation, treatment and disposal: biomedical waste, hazardous waste, construction and demolition waste, e-waste, sanitary napkin (flow chart and one case study of each). Slaughter waste management: concept of rendering plants. Objectives and key points of hazardous and other waste management rules, 2016, construction and demolition (C&D) waste management rules - 2016, E-waste management rules - 2016, plastic waste management rules – 2016, reuse and recycling of plastic waste in road construction, case studies of processing and reuse of construction & demolition waste, material recovered from e-waste, introduction to life cycle assessment (LCA) in solid waste management.

Text Books

01 Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated.
02 Solid waste management, Dr. A.D. Bhide
03 Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI.

Reference Books

01 Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore.
02 CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
03 Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.
04 C for Environmental Scientists and Engineers, Y. Anjaneyulu and Valli Manickam, Wiley Publications.
05 Standard Handbook of Hazardous Waste Treatment and Disposal, Harry Freeman, McGraw-Hill Education, 1998

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 /c1assroom 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 V^{th} 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 V^{th} 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%20Po1icy.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
TE Civil (2019 Pattern) w. e. f. June 2021
301020 b: Elective II: Soft computing Techniques Lab

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

Term Work

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

01 Hand Calculation of network output for any given ANN with sigmoidal, hyperbolic tangent and linear activation functions
02 Implementing standard backpropagation algorithm manually or using spreadsheet
03 Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (univariate) with any appropriate Software.
04 Designing, training, and testing 2-3 layered FFBP ANN using standard backpropagation algorithm for any time series problem (multi-variate) with any appropriate Software.
05 Evaluating the performance of ANN developed in Experiment 3 and 4 by varying number of hidden neurons, activation functions, normalization ranges with any appropriate Software.
06 Designing the model in SVR using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by SVR using two different kernels with any appropriate Software.
07 Designing the model in MT using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by MT using variations of pruning and smoothing etc. with any appropriate Software.
08 Designing the model in RF using the same data base of Experiment no 3 and 4 and evaluating the performance of models developed by RF using potential parameters and parito charts with any appropriate software.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 c: Elective II: Advanced Surveying Lab

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

Term Work

Term work shall consist of the any seven practical and any one project from the following. Term work marks will be based on continuous assessment.

List of Practical

01 Measurement of horizontal and vertical angles using 1" theodolite and digital theodolite.
02 Solution of three-point problem using analytical and graphical method.
03 Measurement of air base distance using mirror stereoscope.
04 Measuring the height of a tower using total station.
05 Setting up stakes for marking the foundation of a building on ground using total station.
06 Measurement of distances, angles, gradient and distance between two inaccessible points using total station.
07 Demonstration of the use of unmanned aerial vehicle (UAV).
08 Measuring the GPS coordinates of ground control points in a mapping survey using any GNSS system.

List of projects

01 Preparing a topographic map using total station and appropriate mapping software.
02 Mapping a given area using a differential GPS.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 d: Elective II: Advanced Geotechnical Engineering Lab

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

Term Work

Term work consists of any 10 assignments out of 12 given below and term work marks will be based on continuous assessment.

01 Soil classification by any method using software/programming.
02 Review of five research papers on clay minerals.
03 Design of cantilever and gravity retaining wall for same problem statement and its comparison using software/programming.
04 Site visit report for any type of retaining wall.
05 One numerical each on UU test, CU test and CD test.
06 One numerical on determination of pore pressure parameters using triaxial test.
07 To draw stress path for isotropic consolidation, one dimensional consolidation, triaxial drained and triaxial undrained test.
08 To draw stress path for undrained slope excavation, stress changes below foundation and near retaining wall.
09 Report on a field case study on soil stabilization using lime/cement/flyash.
10 Case Study of sub grade stabilization using fly ash.
11 Explanation of any one ground improvement technique using a case study and field data.
12 Ground improvement technique – A review of stone column method with the case study.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 e: Elective II: Architecture and Town Planning Lab

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

Term Work

The term work shall consist of a journal from the following. Serial number 1, 2 and 10 are compulsory and any five from remaining. Term work marks will be based on continuous assessment.

01 Study and analysis of development plan with respect to land use, services, infrastructure, street furniture, housing etc. (Group work)
02 Neighborhood planning with its calculation (Group work)
03 Report on contribution of engineers, planners and architects in post-independence India (individual work)
04 Report on any existing new towns or planned towns or satellite towns like new Mumbai, Gandhinagar etc. (in relation with TP aspects inclusive of infrastructure, disaster management etc), (Individual work)
05 Study of salient features of urban renewal schemes (Group work)
06 Study of any existing town planning scheme (Group work)
07 Study of URDPFI OR AMRUT guidelines with a case study (Individual work)
08 Study of special townships or SEZ or CRZ or rural planning strategies (Group work)
09 Study of urban conservation or housing and housing change or ancient sustainable architecture (Group work)
10 E- learning: https://maharera.mahaonline.gov.in with its report (Group work)

Note: For term work, the group size should not be more than five students

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301020 f: Elective II: Solid Waste Management Lab

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

Term Work

Term work consists of following experiments/site visit/Assignments. Any 11 out 18 practical, Sr. No. 1 is compulsory, any 6 practical from Sr. No. 2 to 11 and any 4 practical from Sr. No. 12 to 18. Term work marks will be based on continuous assessment.

01 Report of site visit to municipal solid waste management: Housing society/village/town/city/metropolitan
02 Practical/theoretical (from case study) identification of impacts and problems of improper management of municipal solid waste.
03 Practical/theoretical (from case study) sampling methods and characterization study of municipal solid waste: present and future trend, estimation of quantity of refuse.
04 Determine moisture content and volatile solids for organic faction of municipal solid waste by using oven and muffle furnace.
05 Determine carbon/ nitrogen/ phosphorous content of manure produced from composting process or organic faction of municipal solid waste.
06 Determine calorific value of municipal solid waste by using bomb calorimeter.
07 Practical/theoretical (from case study) municipal solid waste generation rate and estimation of quantity of MSW present and future.
08 Practical/theoretical (from case study) optimization of route network for municipal solid waste collection.
09 Design a composting system for organic waste generated from housing society or city.
10 Design an anaerobic digester for organic waste generated from housing society or city.
11 Design of a sanitary landfill system for any city.
12 Estimation of quantity of leachate and landfill gas emission by using free software such as, bio-transform, HELP, GAISM etc.
13 Identify any construction demolition waste problem and suggest appropriate solution.
14 Prepare a report for cost economics of MSW management for village /town /city etc.
15 Prepare a report for management of e-waste/ biomedical waste/ hazardous waste based on case study or field visit.
16 Report on MSW management by NGO/ ULBs for zero waste management concepts.
17 Prepare a report based on filed visit or case study. Use of Smart Technologies in solid waste management sector- sensors for segregation of waste, using of VTS /GPS/ RFID system and reverse vending machine installed at bus station, railway station.
18 Prepare a report based on filed visit or case study for pay as you pollute or extended producer responsibility (EPR) behavioral analysis in solid waste management.

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301021 a: Audit Course II: Leadership and Personality Development

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

Personality is considered as one of the integral part of an individual‘s existence, where a student is concerned paying close attention to Personality which is extremely important. To enhance holistic development of students and improve their employability skills

Course objectives

01 To develop inter personal skills and bean effective goal oriented team player.
02 To develop professionals with idealistic, practical and moral values.
03 To develop communication and problem solving skills.
04 Tore-engineer attitude and understand its influence on behavior

Course outcomes

On successful completion of this course, the learner will be able to:
01 Enhanced holistic development of students and improve their employability skills

Course Contents

Unit I: Introduction to Personality and working towards developing it

Definition and basic of personality, analyzing strength & weaknesses, corporate the orison personality development, increasing vocabulary, body language, preparation of self introduction

Unit II: Communication skill and handling attitude

Communication skills, listening, communication barriers, overcoming these barriers, building self esteem and self confidence, working on attitudes .i.e. aggressive, assertive, and submissive

Unit III: Leadership Techniques in Personality development

Introduction to leadership, leadership styles, group dynamics, team building

Unit IV: Stress and time management skills

Interpersonal relationships, analysis of ego states, transactions, and life positions, stress management, causes, impact & managing stress, introduction to conflict management, time management, concept of time management, steps towards better time management

Reference books

01 Soft skills, Career Development Centre‖, Green Pearl Publications
02 Seven Habits of Highly Effective Teens, Sean, Fireside Publishers. New York.
03 How to win Friends and Influence People, Carnegie Dale Simon & Schuster, New York.
04 I am ok, You are ok, Thomas A Harris, Harper and Row, New York
05 Emotional Intelligence, Daniel Coleman, Bantam Book

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301021 b: Audit Course II: Industrial Safety

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

Course objectives

01 Health environment and security covers virtually every important area in administration

Course outcomes

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

01 Analyze the safety problem with its solution

Course Contents

Unit I: Introduction of safety

Elements of safety programming, safety management, upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.

Unit II: Safety Performance Planning Safety Performance

An overview of an accident, it is an accident, injury or incident, the safety professional, occupational health and industrial hygiene, understanding the risk, emergency preparedness and response, prevention of accidents involving hazardous substances.

Unit III: Accident Prevention

What is accident prevention, maintenance and inspection, monitoring techniques, general accident prevention, safety education and training.

Unit IV: Safety Organization

Basic elements of organized safety, duties of safety officer, safe work practices, safety sampling and inspection, job safety analysis (JSA), safety survey, on-site and off-site emergency plan, reporting of accidents and dangerous occurrences.

Reference books

01 Industrial Safety, Health Environment and Security, Basudev Panda, Laxmi Publications

02 Industrial safety and Environment, A. K. Gupta, Laxmi Publication

03 Industrial Safety Management, L. M. Deshmukh, Tata McGraw-Hill

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. Repor

Savitribai Phule Pune University, Pune

Syllabus for BE Civil Engineering (2019 Pattern)

Implemented from Academic year 2022-23

Board of Studies in Civil Engineering

Faculty of Science and Technology

Savitribai Phule Pune University, Pune BE (Civil Engineering) 2019 Pattern (With effect from Academic Year 2022-23)																
SEMESTER: VII																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
401001	Foundation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401002	Transportation Engineering	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401003	Elective III	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401004	Elective IV	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401005	Project Stage I	--	04	--	--	--	50	--	50	100	--	01	--	02	--	03
401006	Transportation Engineering **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401007	Elective III **Lab**	--	02	--	--	--	--	--	50	50	--	--	--	01	--	01
401008	Elective IV **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401009	Computer Programming in Civil Engineering	01	02	--	--	--	50	--	--	50	--	02	--	--	--	02
401010	Audit Course I **Stress Management by Yoga / Communication Etiquette in Workplaces**	--	--	01	--	GR	--	--	--	GR	--	--	--	--	--	--
	Total	**13**	**12**	**01**	**120**	**280**	**150**	**--**	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral, TUT : Tutorial, GR: Grade																

Elective III and IV

S N	Course Code	Elective III: Course Name	Course Code	Elective IV: Course Name
01	401003 a	Coastal Engineering	401004 a	Air Pollution and Control
02	401003 b	Advanced Design of Concrete Structures	401004 b	Advanced Design of Steel Structures
03	401003 c	Integrated Water Resources Planning & Management	401004 c	Statistical Analysis and Computational Method
04	401003 d	Finite Element Method	401004 d	Airport and Bridge Engineering
05	401003 e	Data Analytics	401004 e	Design of Prestressed Concrete Structures
06	401003 f	Operation Research	401004 f	Formwork and Plumbing Engineering

SEMESTER-VIII																
Course Code	**Course Name**	**Teaching Scheme (Hours/Week)**			**Examination Scheme and Marks**						**Credit**					
		Theory	**Practical**	**Tutorial**	**IN-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH**	**TW**	**PR**	**OR**	**TUT**	**Total**
401011	Dams and Hydraulics Structures	03	--	--	30	70	--	--	--	100	03	--	--	--	--	03
401012	Quantity Surveying, Contracts and Tenders	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401013	Elective V	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401014	Elective VI	03	--	--	30	70	--	--	--	100	03	--	--		--	03
401015	Project Stage II	--	10	--	--	--	100	--	50	150	--	03	--	02	--	05
401016	Dams and Hydraulics Structures **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401017	Quantity Surveying, Contracts and Tenders **Lab**	--	02	--	--	--	--	--	50	50	--		--	01	--	01
401018	Elective V **Lab**	--	02	--	--	--	50	--	--	50	--	01	--	--	--	01
401019	Audit Course II **Social Responsibility / Human Rights**	--	--	01	--	GR	--	--	--	GR		--	--	--	--	--
	Total	**12**	**16**	**01**	**120**	**280**	**150**	--	**150**	**700**	**12**	**04**	**--**	**04**	**--**	**20**
Abbreviations: TH : Theory, TW: Term Work, PR : Practical, OR: Oral and TUT : Tutorial, GR: Grade																

Elective V and VI

S N	Course Code	Elective V: Course Name	Course Code	Elective VI: Course Name
01	401013 a	Earthquake Engineering	401014 a	TQM and MIS
02	401013 b	Structural Design of Bridges	401014 b	Advanced Transportation Engineering
03	401013 c	Irrigation and Drainage	401014 c	Geo Synthetic Engineering
04	401013 d	Design of Precast and Composite Structures	401014 d	Structural Design of Foundations
05	401013 e	Hydropower Engineering	401014 e	Green Structures and Smart Cities
06	401013 f	Structural Audit and Retrofitting of Structures	401014 f	Rural Water Supply and Sanitation

Programme Outcomes

S N	Programme Outcomes	Programme Outcomes Statement
01	Engineering Knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
02	Problem Analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
03	Design/Development of Solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
04	Conduct Investigations of Complex Problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
05	Modern Tool Usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
06	The Engineer and Society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
07	Environment and Sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
08	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
09	Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project Management and Finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-Long Learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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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 a Elective III: Coastal Engineering

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

Pre-requisites
Fluid Mechanics, Mathematics and Statistics

Course objectives
01 To make students aware about basics of ocean waves
02 To introduce students to the wave properties and analysis
03 To impart knowledge about tides and it's dynamic theory
04 To introduce students to important aspects of longshore transport
05 To impart knowledge about to the coastal structures, shore protection
06 To impart knowledge about coastal management

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand basic of ocean waves including wave generation, classification, propagation, wave theories, wave diffraction, wave refection and wave breaking.
02 Understand and apply short term and long-term wave analysis.
03 Understand basic characteristics of tides, tide producing forces, dynamic theory of tides.
04 Understand coastal process of erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) and estimation of wave induced sediment quantity.
05 Understand the coastal structures and shore protection methods.
06 Understand coastal zone management activities, issues related to integrated coastal zone management and regulation of coastal zone.

Course Content

Unit 1: Basics of Ocean Waves **(06 hours)**
Introduction to wind and waves, Sea and Swell, generation, classification of ocean waves, wave measurement, introduction to small amplitude wave theory, Linear (Airy) wave theory, use of wave tables, introduction to non-linear waves.

Unit 2: Wave Properties and Analysis **(06 hours)**
Basic understanding of wave mechanics including wave propagation, refraction, diffraction, breaking and shoaling, waves in shallow waters, introduction to waves of unusual character: currents, giant waves, tsunami etc, hindcasting and forecasting of waves, short term wave analysis, wave spectra and its utilities, long term wave analysis, statistical analysis of grouped wave data.

Unit 3: Tides **(06 hours)**
Definition and basic characteristics of tide, process of generation of tide, tide producing forces: earth moon and earth sun system, dynamic theory of tides- types of tides- tides and tidal current in shallow sea, storm surges, tides in rivers and estuaries, tidal power.

Unit 4: Coastal Processes **(06 hours)**

Coastal process: erosion/accretion due to waves, bed forms, long shore transport (Littoral drift) estimate of wave induced sediment, budget, tides, effect of tides, stability of inlets, effect of construction of coastal structures on stability of shoreline/beaches.

Unit 5: Coastal Structures and Shore Protection **(06 hours)**

Introduction to coastal structures and their types, concept of risk analysis and design waves along with the concept of break water, introduction and necessity of shore protection, methods of shore protection, groins, seal walls, offshore breakwaters, and artificial nourishment.

Unit 6: Coastal Management **(06 hours)**

Introduction to coastal zones: beach profile, surf zone, off shore zone etc, introduction to coastal waters, coastal sedimentation, estuaries, wet lands and lagoons, coastal dunes. pollution in coastal zone, disposal of waste/dredged spoils, oil spills and contaminants, coastal zone management: activities in coastal zone, CRZ, issues related to integrated coastal zone management, coastal regulation zone.

Text books

01 Coastal Hydrodynamics, J.S.Mani, PHI India Publications

02 Ocean wave Mechanics-Applications in Marine Structure, V.Sundar, Ane Books Pvt Ltd

03 Harbour and Coastal engineering Vol I & II, Ocean and Coastal Engineering Publication

Reference Books

01 Port planning, Qeen A. D. Mc Grow Hill Book Co. New York.

02 Coastal engineering, Vol-I-II, Silvester Richard, University of Western Australia.

03 Shore Protection Manual, U. S. Waterways Experiment Station Corps of Engineer.

04 Costal Engineering Research Center, Vickburg and USA1984,Coastal Protection Manual 2002.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 003 b Elective III: Advanced Design of Concrete Structures

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

Pre-requisites
Structural analysis and fundamentals of RC design.

Course objectives
01 To provide the students with advance design concepts of reinforced concrete structures.
02 To analyze, design and detail different types of reinforced concrete structures.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand yield line theory and apply it to analyze and design slabs of different shapes having different edge conditions.
02 Understand the concepts of ductile detailing
03 Analyze and design of flat slab.
04 Analyze and design of retaining walls.
05 Analyze and design of liquid retaining structures.
06 Analyze and design of RC frames and shear walls.

Course Content

Unit 1: Flat Slabs (06 hours)
Flat slabs, types, design methods, proportioning of flat slab, design moments, direct design method, distribution of moments, design of an intermediate panel, design of end panel, detailing of flat slab.

Unit 2: Yield Line Analysis and Design of Slabs (06 hours)
Yield line theory, assumptions, yield line patterns, characteristics of yield lines, equilibrium and virtual work method of analysis, analysis of rectangular, triangular, circular slabs with various edge and loading conditions using the yield line theory.

Unit 3: Earth Retaining Structures (06 hours)
Types of retaining walls, various backfill conditions, design of cantilever type retaining walls for different backfill conditions.

Unit 4: Liquid Retaining Structures (06 hours)
Types of liquid retaining structures, code provisions, analysis by approximate method and by using IS code method, design of circular and rectangular water tanks resting on ground.

Unit 5: Design of Shear wall and Ductile Detailing (06 hours)
Functions of shear walls, types of shear wall, code provisions, design of shear wall for given lateral loads.

Unit 6: Analysis and Design of RC Frames **(06 hours)**

Seismic coefficient method, substitute frame analysis, analysis of frames subjected to a load combination of gravity and lateral loads. Design of all elements of a frame subjected to combined effect of gravity and lateral loads.

Textbooks

01 Advanced Reinforced Concrete Design, N Krishnaraju, CBS Publishers and Distributors

02 Reinforced Concrete Design, S Unnikrishna Pillai, Devdas Menon, McGraw Hill Publications

03 Reinforced Concrete design, Vol I and II, Dr .H. J. Shah, Charotar Publishing house.

04 Advance R. C. C. Design, S. S. Bhavikatti, New Age International Publishers

05 Reinforced Concrete Structures Vol. II, B.C. Punmia, Ashok K. Jain, Arun K. Jain, Laxmi Publications, New Delhi

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

Reference books

01 Design of Reinforced Concrete Structures, by Ramamrutham S, Dhanpat Rai Publications

02 Advanced Reinforced Concrete Design, P. C. Varghese, Prentice Hall of India Pvt. Ltd., New Delhi

03 Fundamentals of Reinforced Concrete, N. C. Sinha, S.K. Roy, S. Chand & Co. Ltd, New Delhi

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.

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.

03 IS: 456-2000, Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.

04 IS: 3370-2021, Indian Standard code of practice for concrete structures for storage of liquids, 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
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
401 003 d: Elective III: Finite Element Method

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

Pre-requisites
Basics of matrix and matrix operations

Course objectives
01 To learn basic principles of finite element analysis procedure.
02 To learn the theory and characteristics of finite elements that is used in the analysis of engineering structures.
03 To develop the knowledge and skills needed to analyze structural problems by using finite element method.

Course outcomes
On successful completion of this course, the learner will be able to,
01 To understand the basics of solid mechanics prior to learn finite element analysis.
02 Solve simple Engineering problems using 1D, 2D and 3D elements
03 Write shape functions of 1D, 2D and 3D elements
04 Determine the stresses in three dimensional finite elements using isoparametric formulation.
05 Analyze the truss and beam elements using stiffness matrix and finite element procedure.
06 Evaluate the forces and stresses in rigid jointed portal frame and grid elements using stiffness matrix and finite element procedure.

Course Content

Unit 1 **(06 hours)**
Theory of elasticity: strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems and Airy's stress function.

Unit 2 **(06 hours)**
General steps of the finite element method, applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria, Stability and possible sources of errors, principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit 3 **(06 hours)**
Displacement function for 2D triangular (CST and LST) and rectangular elements, use of shape functions, area co-ordinates for CST element, shape functions in Cartesian and natural coordinate systems, derivation of expressions for element stiffness matrix and element nodal load vector using

principle of stationary potential energy, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.

Unit 4 **(06 hours)**

Introduction to 3D elements such as tetrahedron and hexahedron, theory of isoparametric elements: isoparametric, sub parametric and super-parametric elements, characteristics of isoparametric quadrilateral elements, iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, formulation of stiffness matrix for 1D and 2D Isoparametric elements in plane elasticity problem.

Unit 5 **(06 hours)**

Formulation of stiffness matrix, analysis of spring/bar assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, element matrices, assembling of global stiffness matrix, solution for displacements, reactions, stresses, applications to truss and beam not involving unknowns more than three.

Unit 6 **(06 hours)**

Formulation of stiffness matrix using member approach for portal frame and grid elements, transformation matrix, element matrices, assembling of global stiffness matrix, solution for displacements, reactions, stresses, applications to frame and grid not involving unknowns more than three, introduction to computer program algorithm and flowchart.

Textbooks

01 Introduction to Finite Elements in Engineering, T. R. Chandrupatla and A. D. Belegundu, Prentice Hall Publication

02 A First Course in the Finite Element Method, D. L. Logan, Cengage Publications.

Reference books

01 Introduction to the Finite Element Method, Desai and Abel, CBS Publishers & Distributors, Delhi

02 Matrix, Finite Element, Computer and Structural Analysis, M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.

03 Finite Element Analysis - Theory & Programming, C. S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.

04 An Introduction to the Finite Element Method, J. N. Reddy, TATA Mc Graw Hill Publishing Co. Ltd.

05 Theory & Problems -Finite Element Analysis, G. R. Buchanan, Schaum‘s Outline series. TATA Mc Graw Hill Publishing Co. Ltd.

06 Finite Element Analysis, S. S. Bhavikatti, New Age International (P) Ltd.

07 The Finite Element Method, O. C. Zien kiewicz, TATA Mc Graw Hill Publishing Co. Ltd.

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

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

Pre-requisites

Engineering and discrete mathematics, basics of civil engineering

Course objectives

01 Impart knowledge and develop the ability of students to analyze the data for a given problem and represent in the mathematical and statistical form
02 Impart knowledge and develop the ability of students to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis
03 Impart knowledge and develop the ability of students to carry out test of hypothesis, and apply the concept of correlation and regression.
04 Impart knowledge and develop the ability of students to understand concept of machine learning and apply Regression, classification and clustering techniques

Course outcomes

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

01 Understand the basic concepts of Statistics and its analysis and applications
02 Solve the problems related to probability and various probability distributions.
03 Apply the concept of sampling and distribution and interpret problems using correlation
04 Analyze and test of hypothesis
05 Examine and prepare the data and use develop regression
06 Understand and Apply machine learning algorithms for Regression, Classification and Clustering

Course Content

Unit 1: Data Analysis (06 hours)

Types of data, levels of data, types of variables, data science, data analytics, classification of data analytics, importance of data analytics, central tendency: mean mode, percentile, and dispersion: skewness, kurtosis, range, variance, and coefficient of variation, histogram, scattergram; uncertainty & outliers.

Unit 2: Probability Distribution (06 hours)

Introduction to probability and probability distribution, continuous probability distribution: probability density function; normal (Gaussian's) probability distribution; properties of normal curve; lognormal distributions; exponential distribution. Discrete probability distribution: binomial probability, Poisson probability; gamma distribution; case studies: use of dataset/ problems in the field of civil engineering

Unit 3: Sampling distribution and Correlation (06 hours)

Sample, Types of samples, sample mean, Concept of Sampling Distributions; Impact of Sample Size on Sampling Distribution; Sampling Distribution of the Mean and the Central Limit, sample

proportion, sample size determination, Correlation, coefficient of determination, correlation analysis, coefficient of correlation, Rank of correlation.

Unit 4: Hypothesis Testing **(06 hours)**

An estimator or point estimator, confidence interval; estimation of population mean, proportion, cd variance; student's t distribution; chi-square distribution. Confidence interval and hypothesis testing; null and alternative hypotheses; test statistics and rejection regions; critical values; one- or two-tailed test; introduction to type i and type ii errors, P value, F, chi- square, Z and T- test.

Unit 5: Prediction **(06 hours)**

Data analytics life cycle, data cleaning, data transformation, comparing reporting and analysis, analytical approaches: prediction, regression, general multiple regression model, computation of coefficients of the first order multiple regression model using least square method, non-linear regression, residual analysis.

Unit 6: Introduction to Machine learning **(06 hours)**

Introduction to machine learning introduction to machine learning and concepts, types of machine learning: supervised, unsupervised, reinforced learning, over fitting and train/test splits, regression: logistics regression, classification: decision trees, clustering: K means, support vector machines.

Text books

01 Statistical Methods, 43rd Edition, Gupta S. P, S. Chand Publication.

02 Higher Engineering Mathematics, 42nd edition, Grewal B. S, Khanna Publishers.

03 Probability and Statistics for Engineers: 9th edition, Johnson Richard A., Miller I., Freund J.E ,PHI publications.

04 Machine Learning: Jeeva Jose, Khanna Publishing House, Delhi.

Reference books

01. Probability and Statistics for Science and Engineering, Rao G. S, Universities press publication.

02. Applied statistics and probability for engineers, Montgomery, Douglas C. and George C. Runger, John Wiley & Sons.

03. Basic Engineering Data Collection and Analysis, Stephen B. Vardeman and J. Marcus Jobe, Duxbury Thomson Learning.

04. Machine Learning, Chopra Rajiv, Khanna Publishing House.

05. The elements of statistical learning, Hastie, Trevor et al., New York: Springer.

06. Machine Learning: An Artificial Intelligence Approach, Ryszard, S., Michalski, J. G. Carbonell and Tom M. Mitchell, Volume 1, Elsevier.

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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. 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 b Elective IV: Advanced Design of Steel Structures

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

Prerequisites:
Basic concept of Structural Analysis, Mechanics of Materials and fundamentals of design of steel structures

Course Objectives:
1. To study design of member subjected to combined forces with its connections
2. To study the design of section other than hot rolled steel section
3. To study the design of components of industrial structures

Course Outcomes:
At the end of the course, the learners will be able to
1. Understand the behavior and design of members subjected to combined forces
2. Design moment resisting connection
3. Design component / structure using cold form light gauge section
4. Design members of truss and scaffolding using tubular section
5. Design castellated beam
6. Analyze and design components of industrial structure such as Portal frame and gable frame

Course contents

Unit 1: Design of members subjected to combined forces (06 hours)
Introduction, combined shear with bending, design of section subjected to high shear, combined axial force and bending moment, section strength and member strength, design of beam column

Unit 2: Design of moment resisting connection (06 hours)
Type of connections, Moment Resisting Connections, Beam to Beam and beam to column connection, design of web and flange splice using bolt and weld

Unit 3: Cold form light gauge section (06 hours)
Introduction, advantage, type of cross section, stiffened multiple stiffened and un-stiffened element, flat-width ratio, and effective design width, design of compression, tension and flexural members using cold form light gauge section

Unit 4: Tubular Structures (06 hours)
Introduction, design of tubular trusses and scaffoldings using circular and rectangular hollow sections as per code, detailing of joints and design of Connections

Unit 5: Design of Castellated beam (06 hours)

Concepts, fabrication of the castellated beam from rolled steel section, advantage, mode of failure, design of castellated beam for bending and shear as per codal provisions by limit state method

Unit 6: Portal and gable frame **(06 hours)**

Introduction, plastic analysis of portal and gable frame, design of portal and gable frame as per limit state method by limit state method

Text books

01 Limit state design of steel structures, S K Duggal, Tata McGraw Hill Education, New Delhi.

02 Design of steel Structures, Volume II, Ram Chandra, Standard Book House, 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 by V L Shah and Gore, Structures Publication, Pune

05 Punmia and Jain, Comprehensive Design of steel structure, Laxmi Publication, New Delhi

IS Codes

01 IS: 800-2007, Code of practice for General Construction in steel, Bureau of Indian Standard, New Delhi.

02 IS: 806- Code of practice for use of steel tubes in general building construction, Bureau of Indian Standard, New Delhi.

03 IS: 811, Specification for cold formed light gauge structural steel sections, Bureau of Indian Standard, New Delhi.

04 IS: 875 ((Part I to V) Code of practice for design loads for buildings and structures, Bureau of Indian Standard, New Delhi.

05 IS: 801 - 1975, Code of Practice for use of cold formed light gauge steel structural members' in general building construction, Bureau of Indian Standard, New Delhi.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 004 c Elective IV: Statistical Analysis and Computational Methods

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

Pre-requisites
Engineering mathematics, ccollection, classification & representation of data, permutations and Combinations

Course objectives
01 Engineers with the ability to analyze the data for a given problem and represent in the mathematical and statistical form
02 Engineers with ability to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis
03 Engineers with the ability to carry out test of hypothesis, and apply the concept of correlation and regression, goodness of fit and distributions

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand the basic concepts of Statistics and perform statistical data analysis
02 Understand the concept of probability and fit Binomial, or Poisson or Normal distribution to the given data
03 Understand concept of sampling and perform chi-square test, z test, Student T test
04 Perform hypothesis test
05 Carry out correlation and regression analysis for the given data
06 Calculate variance and perform K-S test for goodness of fit

Course Content

Unit 1: **Introduction to Statistics** **(06 hours)**
Statistical methods: introduction, collection, classification and representation of data, various databases related to civil engineering applications (like hydrological, structural audit, etc) measures of central value (mean, median, mode), measures of dispersion, skewness, moment, Kurtosis.

Unit 2: **Probability and Distributions** **(06 hours)**
Probability and probability distributions including binomial, Poisson, normal: examples based on each distribution preferably based on various civil engineering problems.

Unit 3: **Data Sampling** **(06 hours)**
Population, sampling: meaning, 4 types of sampling, importance of population sampling, sample size determination, Chi-square test, Z test, student T test, examples to be framed and solved based on various databases related to civil engineering applications (like hydrological, structural audit, etc)

Unit 4: **Test of Hypothesis** **(06 hours)**
Test of hypothesis: three parts of hypothesis, steps in hypothesis testing: assumptions, test statistics, rejection region, calculations and conclusions, characteristics and qualities of a good hypothesis, students may use hypothesis (if any) from their PBL topic from SE civil curriculum, or any other suitable hypothesis example pertaining to civil engineering applications.

Unit 5: **Correlation and Regression** **(06 hours)**

Correlation analysis, regression analysis, coefficient of correlation, probable error, single and multiple regression, sample examples to be developed through data collected in unit iii and carry out correlation regression analysis for the same.

Unit 6: **Variance and Fitness Test** **(06 hours)**

K-S test for goodness of fit and distribution, analysis of variance on way and two-way classification, examine data using suitable data and frame examples to carry out analysis of variance and use classification rules for the same.

Text Books

01 Statistical Methods , S. P. Gupta, Sultan and Chand Sons

02 Higher Engineering Mathematics, B. S. Grewal, Publisher: Khanna Publishing House.

Reference Books

01 Probability and Statistics for Engineers, Richard A Johnson

02 An Introduction to Statistical Methods and Data Analysis Student Solutions Manual, R. Lymann Ott and Michael Longnecker, Jackie Miller

03 Statistical Methods, Rudolf Freund William Wilson, Academic Press USA

04 Probability and Statistics for Science and Engineering, G Shankar Rao

05 Fundamentals of Statistics, S C Gupta, Himalaya Publishing House

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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. July 2022
401004 e Elective IV: Design of Prestressed Concrete Structures

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

Pre-requisites
Structural Mechanics, Structural Design: Concrete or equivalent course

Course objectives
01 To introduce the students to the basic concepts and principles of prestressed concrete structures.
02 Develop an insight into the behavior of prestressed concrete structural members both at service loads and overloads.
03 To explain fundamentals of prestressed concrete design.
04 To understand the applications of precast prestressed components in civil infrastructure.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Know the prestressed members.
02 Determining the stresses and various losses in prestressed concrete members.
03 Design the prestressed concrete structures
04 Design the prestressed concrete slab
05 Design the prestressed concrete flat slab
06 Analysis and design the prestressed continuous beams

Course Content

Unit 1: Prestressing Systems, Material Properties and Composite Sections (06 hours)
Basic concept, early attempts of prestressing, brief history, development of building materials, definitions, advantages of prestressing, limitations of prestressing, types of prestressing, prestressing systems and devices, introduction of composite sections of prestressed concrete beam and cast in-situ RC slab.

Unit 2: Analysis of Prestressed Members and Losses in Prestress (06 hours)
Analysis of prestressed concrete member, stress calculations and concept of cable profile and losses in prestressed concrete

Unit 3: Design of Determinate Beam (06 hours)
Design of post tensioned prestressed concrete simply supported rectangular and flanged sections for flexure and shear including end block.

Unit 4: Design of Slab (06 hours)
Design of one way and two way post tensioned slabs.

Unit 5: Design of Flat Slab (06 hours)
Introduction to flat slab, design of prestressed two way flat slab by direct design method

Unit 6: Statically Indeterminate PSC Beams **(06 hours)**

Analysis and design of two span continuous beams, choice of cable profile, linear transformation and concordancy.

Text books

01 Advanced Design of Structures, Krishnaraju, Mc Graw Hill.
02 Prestressed Concrete, N. Krishna Raju, Tata Mc Graw Hill Publication Co.
03 Earthquake Resistant Design of Structures, Agarwal and Shrikhande, PHI learning.

Reference books

01 Prestressed Concrete: A Fundamental Approach, Edward Nawy, PHI.
02 Design of Prestressed Concrete Structures, T Y Lin and N H Burns.

Indian Standards

01 IS: 1343: Indian Standard Code of Practice for Prestressed Concrete, Bureau of Indian Standard, New Delhi.
02 IS: 456: Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standard, New Delhi.
03 IS: 1893: Indian Standard Code of Practice for Criteria for Earthquake Resistant Design ff Structures, Bureau of Indian Standard, New Delhi.
04 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.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401004 f Elective IV: Formwork and Plumbing Engineering

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

Pre-requisites

Structural analysis, concrete technology, building technology

Course objectives

01 Exposure to formwork procedures in construction practice
02 Study different types of formwork, analysis and design of formwork
03 Exposure of type and components of plumbing.
04 Study different provision for the design of plumbing system.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Select appropriate material and type of formwork
02 Analyze the formwork for various loadings.
03 Illustrate the design aspects of formwork under various requirements.
04 Understand requirement of plumbing in a building.
05 Understand plumbing hydraulics and its components in plumbing system.
06 Illustrate the design aspects as per the requirement of Indian Standards.

Course contents

Unit 1: Formwork Introduction (06 hours)

Introduction to formwork as a temporary structure, formwork requirements, selection, classification (types) of formwork; Conventional formwork material like timber, plywood, steel; Advanced formwork material like aluminium, plastic, fibre reinforced polymer (FRP) composite materials; Accessories; Economy in formwork; Planning for formwork.

Unit 2: Formwork Analysis (06 hours)

Typical illustrative forms for walls, beams, column and slab with detailing, loads on formwork: dead loads, live loads, lateral pressure due to fresh concrete as per IS 14687: concrete density, height of discharge, temperature, rate of placing, consistency of concrete, vibration, hydrostatic pressure and pressure distribution, examples, design considerations, allowable stresses, deflection limits, common deficiencies in design.

Unit 3: Formwork Design (06 hours)

Formwork design concepts for slab, beams, columns and footing, design of formwork for slabs and wall, illustration of formwork system for beams and, columns

Unit 4: Introduction to Plumbing in Buildings (06 hours)

Water borne disease, importance of premise plumbing, history of plumbing, codes on plumbing, organizations and institutes in plumbing across India and the world, need for sustainable practices in

plumbing, role of plumbing designer, role of plumber, plumbing system installations, future challenges in plumbing.

Unit 5: Plumbing Hydraulics and components of the plumbing system (06 hours)

Frictional losses in pipes, minor losses in pipes, common plumbing fixtures, water efficient fixtures, pipe materials and roughness coefficients, types of fittings, types of valves, types of traps, equivalent lengths for fittings and valves as per standards, water demand in different types of buildings as per standards, components of water supply systems in buildings, types of water supply systems in buildings, types of drainage systems in buildings.

Unit 6: Plumbing system design (06 hours)

Code provisions on pressure and velocity in plumbing systems, simultaneous demand, different methods of pipe sizing in building (fixture unit, water demand calculator, fixture value method, etc.), fixture unit method of pipe sizing in building, water supply fixture units and drainage fixture units for different plumbing fixtures, sizing pipes of 3- storey building using segmented loss method, the layout of plumbing fixtures in a toilet, plumbing plans of buildings.

Text Books

01 Modern Practices in Formwork for Civil Engineering Construction Works, Dr. Janardan Jha & Prof. S. K. Sinha, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.

02 Formwork for Concrete Structures, Robert L. Peurifoy and Garold D. Oberlender, McGrawhill Publication.

03 Plumbing: Design and Practice, Deolalikar S. G., Tata Mcgraw-Hill Publication.

04 Water Supply and Sanitary Installation (Within Building), Design, Construction and Maintenance Panchdhari A. C., New Age International publishers.

Reference Books

01 Formwork by Michael P. Hurst, Addison-Wesley Longman Ltd; First Edition (June 1, 1983).

02 Formwork for Concrete, Hurd, M.K., Special Publication No.4, American Concrete Institute, Detroit; Fifth edition

03 Design and Construction of Formwork for Concrete Structures by A.E. Wynn, George Philip Manning, Cement & Concrete Association.

04 Austin C.K., Formwork for Concrete, Cleaver-Hume Press Ltd., London, 1996.

Indian Standards

01 IS 6461: Part V: 1972, Reaffirmed 2002; Glossary of terms relating to cement concrete: Formwork for concrete, Bureau of Indian Standard, New Delhi.

02 IS 14687: 1999, Falsework for Concrete Structures – guidelines, Bureau of Indian Standard, New Delhi.

03 IS 12183-1-1987, Code of practice for plumbing in multi-storeyed buildings (Part 1 water supply), Bureau of Indian Standards, New Delhi, India.

04 Uniform Illustrated Plumbing Code - India 2018, International Association of Plumbing and Mechanical Officials India.

05 International Plumbing Code - 2018, Appendix E, International Code Council, USA.

06 National Building Code of India - 2016, Vol. 2, Part 9, 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
401 005: 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
401006: Transportation Engineering 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.

A. Practical

I. Tests on Aggregate (Any Five)

1 Aggregate Impact Value Test
2 Aggregate Crushing Strength Test
3 Los Angeles Abrasion Test
4 Shape Test (Flakiness Index and Elongation Index)
5 Specific Gravity and Water Absorption Test by basket method
6 Stripping Value Test
7 Soundness Test

II. Tests on Bitumen (Any Five)

1 Penetration Test
2 Ductility Test
3 Softening Point Test
4 Flash Point & Fire Point Test
5 Bitumen Extraction Test (compulsory)
6 Viscosity Test (Tar Viscometer)
7 Specific Gravity Test

III. Tests on Aggregate Bitumen Combined: (Compulsory)

1 Marshall Stability Test

B. Technical visits

1. Road Construction and/or RAP Site
2. Hot mix Plant with detailed report

C. Mandatory Assignments

1. Construction process of GSB, WBM, WMM; Cemented base, Introduction to bituminous works such as prime coat, tack coat, seal coat

2. Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet, Dry lean Concrete (DLC), Pavement Quality Concrete (PQC)

3. Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Concept of Super pave Mix Design (Super pave Series 2), Non-Destructive Evaluation of Pavements (Falling Weight Deflect meter FWD)

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401007 a Elective III: Coastal Engineering 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 Assignment on Linear (Airy) wave theory
02 Assignment on calculation of wave refraction, diffraction, wave breaking and shoaling
03 Assignment on hindcasting of waves / short term wave analysis
04 Assignment on long term wave analysis/ statistical analysis of wave data.
05 Assignment on dynamic theory of tides.
06 Assignment on Coastal process of erosion/accretion due to waves / bed forms.
07 Assignment on long shore transport (Littoral drift) / estimation of wave induced sediment, budget.
08 Assignment on effect of construction of coastal structures on stability of shoreline / beaches (case studies)
09 Assignment on methods of shore protection /groins, seal walls, offshore breakwaters/ artificial nourishment (case studies)
10 Assignment on pollution in coastal zone/ disposal of waste/dredged spoils (case studies)
11 Assignment on coastal zone management: activities in coastal zone, CRZ, Issues related to Integrated coastal zone management / Coastal regulation zone (case studies)
12 Site visit to actual port / port models and preparing the report

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 007 b Elective III: Advanced Design of Concrete Structures 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 Assignment on analysis of slab using yield line theory
02 Design and detailing of flat slab
03 Design and detailing of retaining wall.
04 Design and detailing of ground resting water tank
05 Design and detailing of RC frame
06 Design and detailing of shear wall
07 Report on a site visit of ongoing construction of any structure mentioned in the syllabus
08 The drawings shall be prepared on full imperial drawing sheets. Detailing of reinforcement should be as per latest provisions of code.

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

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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
401 007 d Elective III: Finite Element Method 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 At least one assignment on each unit consisting minimum five numericals/theory questions.

02 One assignment based on FEM by using coding tools with program algorithm and flowchart for the following.
a) Formulation of stiffness matrix for any 1-D element.
b) Formulation of stiffness matrix for any 2-D element using isoparametric formulation.

03 Finite Element Method: Software applications of any one cases using suitable standard available software.
a) Truss/grid/beam/frame problem.
b) Plane stress/plane strain problem.

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

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

Term Work

Term work consists of the following assignments, out of twelve 2, 4, 6, 8, 10 & 12 are compulsory and any 4 out of remaining 6. Oral examination based on the term work

01 Determine mean, mode, kurtosis, coefficient of variation etc.
02 Determine measures of central tendency for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
03 Assignment on continuous probability distribution and discrete probability distribution.
04 Assignment on Probability distribution for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
05 Assignment on Sampling distribution, sample size determination and coefficient of correlation.
06 Assignment on Sampling distribution and Correlation for a a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
07 Assignment on test of hypothesis.
08 Assignment on test of hypothesis for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
09 Assignment on Regression.
10 Assignment on Regression for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.
11 Assignment on introduction to machine learning
12 Assignment on Logistic regression, Decision Trees, K means or Support Vector Machine (any two) for a Civil Engineering dataset using Microsoft Excel/Python/Matlab/SPSS or any other suitable platforms.

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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. June 2022
401 008 a Elective IV: Air Pollution and Control 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. Experimental Performance and Demonstration (S. N. 1 and 2 Compulsory and any 02 out of S. N. 3, 4 and 5)

01 Sampling and analysis of PM_{10} and $PM_{2.5}$ using (High Volume Sampler/ Fine Dust Sampler) in Ambient Air.
02 Sampling and analysis of SO_2 and NO_2 (High Volume Sampler/ Fine Dust Sampler) in Ambient Air.
03 Demonstration and report of Sampling and Analysis of PM_{10} & $PM_{2.5}$ using portable aerosol Spectrometer with the help of information and communication technology (ICT).
04 Demonstration and report of Stack Emission Monitoring (Isokinetic Sampling) with the help of information and communication technology (ICT).
05 Demonstration and report of Indoor Air Quality Assessment using Multi Gas Monitor with the help of information and communication technology (ICT)

B. Visits and Interactive Sessions (S. N. 4 is compulsory and any 01 out of S. N. 01, 02 and 03)

01 Visit to India Meteorological Department with reference to monitoring of meteorological parameters and its report.
02 Visit to air quality monitoring station and its report.
03 Visit to industry (sugar/cement/steel/thermal power plant/rubber/dairy) with reference to air pollution control device(s) and its report.
04 An interactive session with experts from Indian Institute of Tropical Meteorology/ Central Pollution Control Board/ State Pollution control board/ Municipal corporation or Nagar Panchayat/ smart city centers/ National Environmental Engineering Research Institute (NEERI)/any authority with reference to air quality and its report.

C. Reports and Case Studies (Any 03 of the following)

01 A report on "Application of remote sensing and satellite-based data in air quality management".
02 A report on "International Environmental Treaties to Reduce Air Pollution and GHG Emissions".
03 A report on "Impact of Lockdown on air quality".
04 A Report on "Sector Wise (Transportation/ Thermal Power plants/ Industries/ Domestic/ Agriculture) Mitigation Measures to Control Air Pollution".
05 A report on "Challenges and the Way forward to mitigate Air Pollution".
06 A case study report on "Ozone layer depletion/ Global warming/ Climate change/ acid rain".
07 A case study report on "Wind rose diagram construction and application using freeware".
08 A report on "Status of Air Quality Status of any city".
09 A report on any model (Screen3/ ISC/ CALINE4/ HIWAY2/ CAR-FMI/ OSPM/ CALPUFF/ AERMOD/ ADMS).

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 b Elective IV: Advanced Design of Steel Structures 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. One assignment on each unit

01 Design of Beam Column
02 Design of beam to beam or beam to column connections
03 Design of cold form flexural member (Preferably purlin on sloping roof)
04 Design of rafter using tubular cross section with design of Connections showing detailing of joints
05 Design of castellated beam
06 Design of portal / gable frame

B. Two site visit cold formed light gauge section/tubular structure and gable frame

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 c Elective IV: Statistical Analysis and Computational Methods 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.

01 Exercise/Assignment on Introduction to Statistics
02 Exercise/Assignment on probability and distributions
03 Exercise/Assignment on data sampling
04 Exercise/Assignment on test of hypothesis
05 Exercise/Assignment on correlation and regression
06 Exercise/Assignment on variance and fitness test
07 Out of above at least two exercise/assignment to be solved using Excel or SPSS or Any other software suitable for statistical analysis

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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
401 008 e Elective IV: Design of Prestressed Concrete Structures 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 /design

01 Assignment on introduction, prestressing systems and material properties, composite sections
02 Assignment on calculation of losses in prestress and stress calculation
03 Design and detailing of design of prestressed concrete determinate beam
04 Design and detailing of prestressed concrete slab
05 Design and detailing of prestressed concrete flat slab.
06 Design and detailing statically indeterminate PSC beams
07 One site visit reports, on prestressed concrete structure.
08 Minimum Two full imperial sheets based on two projects on design of prestressed concrete structural elements.

Note: Should be separate design problem statement for a group of students not exceeding five.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 008 f Elective IV: Formwork and Plumbing 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.

01 Assignment on design of timber/steel formwork for slab. (Group of maximum Five students)
02 Assignment on design of timber/steel formwork for wall. (Group of maximum Five students)
03 Prototype model of any formwork (Group of maximum Five students)
04 Analysis and design of any formwork using suitable software.
05 Prototype model of plumbing for G + 2 building (Group of maximum Five students)
06 Assignment on design of plumbing
07 Assignment on plumbing system installation as Indian Standard.
08 Assignment on plumbing hydraulics and plumbing components
09 Reports of two site visits.
   i. One site visit to observe conventional formwork and formwork for special structure or special formwork.
   ii. One site visit to industrial plumbing system

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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	**Credits**	**Examination scheme**
Theory: 01 Hours/week	02	In semester Exam: NA
		End semester Exam: NA
Practical: 02 Hours/week		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
401010 Audit Course I a: Stress Management by Yoga

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

Pre-requisites
None

Course objectives
01 Understanding concept of Yoga and its benefits
02 Learn different types of Yogasans
03 Develop an understanding and stress importance of Meditation
04 Learn different techniques of Pranayam

Course outcomes
On successful completion of this course, the learner will be able to:
01 Develop understanding of Yoga and its impact on human body and mind.
02 Learn different Yogasans
03 Develop an understanding of meditation through pranayama
04 Learn different techniques of Pranayam

Course Contents

Unit I: Yoga: Sukshma (subtle) yoga techniques, difference between physical exercises and yogasans, impact of yogasans on human body, benefits of yogasans, patanjali yoga sutras, technique of different yogasans like, Trikonasan, Ardhachandrasan, Padmasan, Akarnadhanurasan, Ardhamatsendrasan, Vajrasan, Pachhimottanasan, Bhujangasan, Shalbhasan, Dhanurasan, Naukasan, Makrasan, Pawanmuktasan, Halasan, Sarvangasan, Shavasan, Suryanamaskar(Sun Salutation), yoga and food.

Unit II: Meditation: breathing technique, pranayam, benefits of pranayam, precautions for pranayam, Kumbhak, Bandh (Locks), Chakras, Mudra, technique of pranayam, Anulom-Vilom Pranayam, Ujjayi Pranayam, Bhramari Pranayam, Bhastrika Pranayam, Agnisa rPranayam, Kapalbhati Pranayam, Meditation (Dhyan).

Reference books

01 Light on Yoga, B. K .S. Iyengar, Harper Collins Publishers India
02 Light on Pranayama, B. K. S. Iyengar, Harper Collins Publishers India
03 Yoga for Dummies, Georg Feuerstein and larry Payne, Wiley India publishing
04 Yoga, Pilates, Meditation & Stress Relief, Parragon Books Ltd

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401010 Audit Course I b: Communication Etiquette in Workplaces

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

Pre-requisites
None

Course objectives
01 Develop an understanding of workplace codes, professionalism at workplace
02 Understand the workplace ethics
03 Develop an understanding of Business ethics, workplace privacy and ethics
04 Learn teamwork at workplace

Course outcome
On successful completion of this course, the learner will be able to,
01 Develop an understanding of workplace codes, professionalism at workplace
02 Learn the workplace ethics
03 Develop an understanding of Business ethics, workplace privacy and ethics
04 Learn teamwork at workplace

Course Content

Unit I: Ethics in engineering profession and roles of engineers, ethical codes and its need, codes from other profession, advertising standards of India, corporate codes, knowledge of ethical codes. Workplace ethics: needs, principles, development of personal ethics, workplace ethics for employees- ethical behaviour in workplace- professionalism, ethical violations by employees, employee attitude and ethics, employee etiquettes. Benefits of ethics in workplace employee commitment, investor loyalty, customer satisfaction, profits professionalism at workplace: unethical conduct for employees and employers. Factors leading to unethical behaviours, different unethical behaviours, measures to control unethical behaviours, rewarding ethical behaviour

Unit II: Business ethics: overview of business ethics, corporate governance, ethical issues in human resource management- the principal of ethical hiring, firing, worker safety, whistle blowing, equality of opportunity, discrimination, ethics and remuneration, ethics in retrenchment. Ethical dilemmas at workplace, ethical issues in global business, corporate responsibility of employers, workplace privacy & ethics: privacy at workplace, hardware, software and spyware, plagiarism and computer crimes, convenience and death of privacy, defence of employee privacy rights. Teamwork at workplace: teams, elements of team, stages of team development, team meetings, team rules, and teams work and professional responsibility, rules of professional responsibility, ASME code of ethics, discrimination, sexual harassment, creating awareness about workplace harassment, compulsory workplace guidelines, ethics of managing change in workshop.

Reference Books

01 Business Ethics, Kurt Stanberry and Stephen M. Byars, Tata Mc Graw Hill Publisher.

02 A Guide to Corporate Business Etiquette, How to Maintain Effective Communication at Work Paperback, Satish Babu Bachu, 4th Edition, 17 July 2014.

03 The Essentials of Business Etiquette and workplace through ethics, Barbara Pachter, 5th Edition, 2018.

04 The Etiquette Advantage in Business, Personal Skills for Professional Success, Daniel Post Senning, Peter Post, Anna Post, Lizzie Post, Peggy Post, 3rd Edition.

05 Subramanian Business Etiquette: 101 Ways to Conduct Business with Charm & Savvy, Ann Sabath.

06 The Unwritten Rules of Professional Etiquette, Ryan Sharma, 4th Edition.

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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. 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. July 2022
401013 b Elective V: Structural Design of Bridges

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

Pre-requisites

Concepts of structural analysis, Concept of structural steel design, Concept of reinforced concrete structural design, Concept of prestressed concrete

Course objectives

01 Know about various types of bridge structures.
02 Selection of appropriate bridge structures for given site conditions.
03 Analyze and design reinforced concrete, steel and prestressed concrete superstructures.

Course outcomes

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

01 Identify loads on bridges and selection of type of bridge for the site condition as per Indian standards.
02 Design the reinforced concrete deck slab, culvert slab and T beam deck slab for highway bridges.
03 Analysis and design of reinforced concrete and post tension prestressed concrete girders.
04 Classify the types of rail bridges and design the plate girder steel bridges
05 Analyse and design the steel trussed bridges.
06 Study different types of bearing and thereby design the bearings for reinforced concrete highway bridges.

Course Content

Unit 1: Introduction to Highway and Railway Bridges (06 hours)

Types of bridges, classification, IRC loading standard for RC highway bridges, IRC loading standard for railway steel bridges, impact factors for moving loads as per IRC, concept of ILD/moving load and equivalent uniformly distributed load (EUDL).

Unit 2: RC Slab Bridge Deck for Highways (06 hours)

Analysis of slab decks considering cases solid slab spanning in one direction, solid slabs in spanning two direction and solid cantilever slab, design Aids and Tables of RC deck bridge slab as per Pigeaud‘s method, design of slab culvert, Design of RC slabs supported on all sides for T-beam and slab deck.

Unit 3: RC Bridge Girders and Post Tensioned Prestressed Girders (06 hours)

Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders as per Courbon’s theory, design of post tensioned prestressed concrete T beam bridge deck and girders.

Unit 4: Railway Plate Girder Bridges (06 hours)

Railroad bridge philosophy, railroad bridge types, elements of plate girder and their design such as web, flange, vertical stiffeners, end bearing stiffeners, intermediate stiffeners, and lateral bracing for plate girders.

Unit 5: Railway Truss Girder Bridges **(06 hours)**

Types and components, Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit 6: Bridge Bearings **(06 hours)**

General features and function of bearings, types of bearings, design of steel rocker and roller bearings, design of elastomeric pad bearing.

Text books

01 Design of Bridges, N. Krishna Raju, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
02 Design of Bridge Structures, T. R. Jagdish and M. A. Jayaram, Prentice-Hall of India Pvt. Limited., New Delhi.
03 Prestressed Concrete, N. Krishna Raju, Tata-McGraw Hill International.

Reference Books

01 Essentials of Bridge Engineering, Johnson Vector D, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
02 Bridge Engineering Handbook, Wai-Fah Chen and Lian Duan, CRC Press Pvt. Ltd.
03 Bridge Engineering, Ponnuswamy S., Tata McGraw-Hill, New Delhi.
04 Design of Steel Structures, Ramachandra, Standard Publications New-Delhi.
05 Bridge Superstructure, Rajagopalan. N., Alpha Science International, New Delhi.
06 Plain and Reinforced Concrete, Vol.2., Jain and Jaikrishna, Nem Chand Brothers, New Delhi

Indian Standards

01 IS 456:2000, Code of practice for Plain and Reinforced Concrete, BIS, Bureau of Indian Standards, New Delhi.
02 Indian Railway Standard Code of practice for the design of steel and wrought iron bridges carrying rail, Govt of India, Ministry of Railways, 1962.
03 Standard specifications and code of practice for road bridges, IRC section I, II, III, V, VI. VII, and IX.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 c Elective V: Irrigation and Drainage

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, geotechnical engineering, and hydrology and water resources engineering

Course Objectives
01 To study different irrigation and drainage systems.
02 To introduce students about basic concepts of water, plant, and their interactions.
03 To calculate evapotranspiration and crop water requirement.
04 To develop analytical skills relevant to the design of irrigation and drainage projects, planning and management.

Course Outcomes
On successful completion of this course, the learner will be able to:
01 Summarize types of irrigation methods.
02 Estimate evapotranspiration and crop-water requirement.
03 Understand component parts and their design considerations of lift irrigation system.
04 Design drip and sprinkler irrigation systems.
05 Understand basics of salt affected soils and estimate leaching requirement.
06 Design surface and subsurface drainage systems.

Course Contents

Unit 1: Introduction (06 hours)
Definition, necessity of irrigation, benefits of irrigation, ill effects of irrigation, crop pattern, irrigation efficiency, cropping intensity, water use efficiency, canal and pipe distribution system, types of irrigation systems, techniques of water distribution in the farm, factors affecting the choice of irrigation methods, quality of irrigation water. Surface and subsurface irrigation methods, concept of deficit irrigation, micro irrigation (theory only), application of AI in irrigation and drainage.

Unit 2: Soil Moisture and Evapotranspiration (06 hours)
Soil Moisture: soil texture, soil structure, soil groups of India, field capacity, wilting point, maximum allowable deficiency (MAD), kinds of soil water, soil moisture tension, root zone, soil profile, soil-water relationships, soil-moisture characteristic curve, measurement of soil moisture, tensiometer.
Evapotranspiration (consumptive use): direct measurement of evapotranspiration: Lysimeters, field plots; evapotranspiration equations – Penman's equation, FAO Penman - Monteith equation, Blaney-Criddle formula, Thornthwaite formula, reference crop evapotranspiration, procedure to estimate actual evapotranspiration, frequency of irrigation, crop water requirement in peak fortnight, design discharge for canal and pipe distribution system. (**No** numerical should be asked on Penman's and FAO Penman - Monteith equation in theory exam).

Unit 3: Lift Irrigation and Drip Irrigation (06 hours)

Centrifugal pump (CP): working, component parts, heads of CP, NPSH, computation of power requirement, characteristic curves of CP. Lift Irrigation: general concepts, advantages, disadvantages, elements of lift Irrigation schemes, design considerations involved in intake well, jack well, rising main, distribution systems. Drip Irrigation: definition and functions, advantages and disadvantages of drip irrigation systems, suitability of drip irrigation system, wetting pattern (width and depth of wetting front), components of drip irrigation system, planning and design of drip irrigation systems, installation and maintenance of drip assembly.

Unit 4: Sprinkler Irrigation (06 hours)

Introduction of sprinkler irrigation, advantages and limitations of Sprinkler Irrigation, types of sprinkler systems, components of sprinkler Irrigation system (Pumping set, main and lateral pipe lines, sprinkler heads, perforated pipes, debris screen and desilting basin, booster pumps, take off valves and flow control valves, fertilizer applicators), moisture distribution patterns and uniformity of coverage, uniformity coefficient. Design of sprinkler irrigation systems (inventory of resources and conditions, criteria for system layout, selection of sprinkler and its spacing, discharge capacity of the pump, hydraulic design of sprinkler systems- (discharge of sprinkler nozzle, main and lateral pipe sizes, pumps and power units), cost estimation, operation and maintenance.

Unit 5: Management of Salt Affected Soil (06 hours)

Salinity, salinity units, electrical conductivity, pH, quality of irrigation water, sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP), classification of saline and alkaline soils, osmotic potential, salinity stress coefficient, water stress coefficient, yield reduction, salt balance (mass balance) at farm level. Reclamation of saline soils: leaching requirement (LR) - Rhoades equation, requirement of irrigation water to meet crop demand and LR. Reclamation of alkali soils: Gypsum requirement.

Unit 6: Drainage of Irrigated Land (06 hours)

Definition and objectives of drainage, water logging, definition, classification and impact; types of drainage systems, surface, subsurface, vertical or tube well. Surface drainage system: design considerations for land drainage; design considerations for land grading/leveling, design consideration for field drains and field laterals; layout and design considerations of field drains and laterals - random field drain system, bedding field drain system, parallel field drain system; design of surface drainage channel (computation of design discharge only). Subsurface drainage systems: purpose and benefits; location and alignment of drains pipes; sub surface drainage system layouts- random system, parallel grid system, herringbone system, combined system; drain pipe envelope; structures of pipe drainage system- outlet of a pipe drain into a ditch or canal, junctions and inspection chamber, surface water inlets, bedding; drainage coefficient; drain spacing design – steady state formula (Hooghoudt formula), unsteady state formula (Glover-Dumm equation); design of drain pipe diameter; materials for drain pipe – clay, concrete, plastic, drainage wells. (No derivation of Hooghoudt and Glover-Dumm formulae).

Text Books

01 Irrigation Engineering and Hydraulic Structures, Garg, S. K., Khanna Publishers, New Delhi.

02 Irrigation, Theory and Practice, A. M. Michael, Vikas Publishing House Pvt. Ltd. New Delhi.

03 Irrigation Engineering and Hydraulic Structures, S. R. Sahasrabudhe, Kataria & Sons, New Delhi.

04 Engineering Hydrology, K Subramanya, McGraw Hill Education (India) Pv. Ltd.

Reference books

01 Drip and Sprinkler Irrigation, R. K. Biswas, New India Publishing Agency, New Delhi.
02 Land Drainage, Battacharaya A. K. & Michael A. M., Vikas Publ.
03 An introduction to Drip Irrigation Systems, Ajai Singh, New Delhi Publishers.
04 Irrigation Engineering, H. M. Raghunath, Wiley India.
05 Irrigation and Drainage Engineering, Peter Waller and Muluneh Yitayew, Springer.
06 Trickle Irrigation for Crop Production, F. S. Nakayama and D. A. Bucks, Elsevier.
07 Urban Drainage, David Butler and John W. Davies, Taylor & Francis.
08. Guidelines for Planning and Design of Piped Irrigation Network, Central Water Commission, Ministry of Water Resources, River Development & Ganga Rejuvenation, Govt. of India, New Delhi.
09 Pipe Distribution Network for Irrigation", WRD Handbook-Chapter 4 (Vol I, 2019), Water Resources Department, Govt. of Maharashtra.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 d Elective V: Design of Precast and Composite Structures

Teaching scheme	**Credits**	**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, Structural Analysis, Design of Steel and Concrete Structures

Course objectives
01 Learn the concepts and techniques of precast and composite construction.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Achieve knowledge of design and development of problem solving skills.
02 Explore the concept of precast construction.
03 Learn the principles and design of precast structures
04 Understand the need, advantages and limitations of composite material.
05 Apply basic mechanical principles in analysis of composite structures like beams, columns, floors, shear connectors.
06 Understand and apply various provisions as per Indian standards in design of structural components using composite materials.

Course Content

Unit 1: Introduction to Precast Concrete Construction (06 hours)
General principles of fabrication, need for prefabrication, comparison with monolithic construction, types of prefabrication, site and plant prefabrication, economy of prefabrication, modular coordination, standardization, materials, modular coordination, systems, production, transportation, erection.

Unit 2: Production and Fabrication (06 hours)
Production technology, choice of production setup, manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening, hoisting technology, equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

Unit 3: Design of Precast Concrete Elements (06 hours)
Prefabricated load carrying members: types of beams, design of simple rectangular beams and I-beams, handling and erection stresses, elimination of erection stresses in beams, types of Slabs: construction of roof and floor slabs, design of hollow core slab, columns: construction and design principles of column, study of IS: 15916 and their applications.

Unit 4: Introduction to Composite Construction (06 hours)

Introduction to composite construction, basic concepts, types of composite constructions, Steel concrete composite, analysis and design of simply supported composite beams with solid steel beams.

Unit 5: Design of Shear Connectors (06 hours)

Types of shear connectors and its function, analysis and design of shear connection between concrete slab and beam**.**

Unit 6: Design of Composite Columns (06 hours)

Design of steel concrete composite columns, columns subjected to axial loads and moments, encased composite construction of beams and columns, concepts and design, introduction to of IS: 11384 and their applications.

Text Books

01 Design and Construction of Precast Concrete Structures, Ramachandra Murthy D. S., 1st Edition, Dipti Press OPC Private Limited, Chennai.

02 Precast Concrete Structures, Hubert Bachmann and Alfred Steinle, Earns and Sohn.

03 Steel-concrete Composite Structures, Narayanan R, Vol. 7, CRC Press.

Reference Books

01 Handbook of Composite Construction Engineering, Gajanan M. Sabnis and Van Nostrand Reinhold Inc., U.S.

02 Composite Structures of Steel and Concrete: Beams, Slabs, Columns and Frames for Buildings, Roger P. Johnson, 4th Kindle Edition.

03 The Institute for Steel Development & Growth (INSDAG) course Material.

Indian Standards

01 IS 15916: 2010, Code of Practice for Building Design and Erection using Prefabricated Concrete, Bureau of Indian Standards, New Delhi.

02 IS 11384: 1985, Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi

03 IS 3935: 1966, Code of practice for composite construction, 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
401013 e Elective V: Hydropower Engineering

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, hydrology

Course objectives
01 Introduce the energy resources planning and potential concept.
02 Estimate the load factor and study the power house components and layout.
03 Understand the design of hydraulic turbines and study the economic consideration of hydroelectric power.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Understand the classification of power resources & trends in energy use patterns.
02 Identify the components of hydro power plant.
03 Analyze the load assessment for turbines.
04 Prepare the layout of power house based on the various structures need for it.
05 Design the turbines and surge tanks.
06 Understand the laws and regulatory aspects of hydroelectric power.

Course Content

Unit 1: Hydropower Plants & Its Classification (06 hours)
Introduction: sources and forms of energy, types of power plants, and elements of hydropower scheme, hydropower development in India. Power house structures-substructure and superstructure layout and dimensions, deign considerations. Hydropower plants classification: surface and underground power stations, low medium-high head plants-layout and components, pumped storage plants, tidal power plants, micro tidal units.

Unit 2: Energy Resources and Load Assessment (06 hours)
Estimation of electrical load on turbines, load factor, plant factor, peak demand and utilization factor, load curve, load duration curve, prediction of load, tariffs, hydro-thermal mix, combined efficiency of hydro-thermal-nuclear power plants.

Unit 3: Power and Energy Potential study (06 hours)
Processing of hydrological data, use of extreme and long term hydrological data, mass and elevation volume curves, flow duration curves, gross and net head and estimation, reservoirs and their regulation, need for flow regulation, source of sediment, sediment yield in rivers, life of the reservoirs, methods of fixing installed capacity of a hydropower plant, estimation of power and energy potential, mean and peak load, load curve, load factor.

Unit 4: Water Conductor System and Powerhouse (06 hours)
Water conductor system, alignment, intake structures, location and types, trash rack, penstock and pressure shaft, types of powerhouses, typical layout of powerhouse, components, power plant equipment's, instrumentation and control.

Unit 5: Design of Hydraulic Turbines **(06 hours)**

Components of hydraulic turbines, standardization and selection of turbine, Pelton turbine design, Francis turbine runner design, design of axial turbine runner including bulb turbine, draft tube theory, standardization and applications draft tube. Water hammer and surge tanks: rigid and elastic water column theories, water hammer pressure, behavior of surge tanks, types of surge tanks, hydraulic design, design of simple surge tank-stability

Unit 6: Economics of Hydroelectric Power: **(06 hours)**

Hydropower, economic value and cost and total annual cost. economic considerations – pricing of electricity, laws and regulatory aspects, policies, electricity act- 2003, investment in the power sector, carbon credits, participation of private sector.

Text Books

01 Water Power Engineering, Dandekar and Sharma, Vikas Publishin house, New Delhi
02 Water Power Engineering, R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.
03 Irrigation Engineering and Hydraulic Structures, Garg , S. K. Khanna Publishers, New Delhi
04 Water Power Engineering, P. K. Bhattacharya, Khanna Pub., Delhi.
05 Water Power Engineering, M. M. Deshmukh, Dhanpat Rai Pub.

Reference Books

01 Handbook of Hydroelectric Engineering, P. S. Nigam
02 Modern Power System Planning, Wang.
03 Hydropower Resources in India, CBIP
04 Hydro Power Structures, R. S. Varshney.
05 Water Power Development. E. Mosonvi, Vol. I & II.
06 Hydro-electric Engineering Practice, G. Brown, Vol. I, II & III.
07 Hydro – Electric Hand Book, Creager and Justin.
08 Centrifugal and axial flow Pump, A. J. Stephenoff, Krieger Publishing Company.
09 Hydraulic Structures, Novak, P. et al., Taylor and Francis, London.
10 Water Power Development, Volume 1: Low-head Hydropower Plants, Mosonyi, E., Academia Kiado, Budapest.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401013 f Elective V: Structural Audit and Retrofitting of Structures

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

Pre-requisites
Structural analysis and structural design

Course objectives
01 To introduce Structural Audit: its necessity, procedure involved and report writing.
02 To introduce Retrofitting of structures: its necessity, materials & methods for retrofitting, retrofitting of RC, Steel & Masonry structures.
03 To make learners enable to design of retrofitting for RC beams and columns using FRP.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Identify causes of deterioration in RC and steel structures.
02 Explore entire process of structural audit.
03 Explore necessity and methods of structural health monitoring.
04 Explain method of retrofitting for RC, steel and historical structures.
05 Design retrofitting using FRP for RC column.
06 Design retrofitting using FRP for RC beams.

Course Content

Unit 1: Introduction (06 hours)
Causes of structural damages: mechanical actions, chemical attacks, earthquake, fire, damage to steel structures due to corrosion, damage to RC structures due to corrosion: corrosion induced by carbonation of concrete, chloride induced corrosion and corrosion induced by leaching of concrete. Introduction to structural audit, its necessity, introduction to retrofitting of structures, its necessity, repairs, difference between repairs and retrofitting

Unit 2: Structural Audit (06 hours)
Structural audit, assessment of health of structure, study of structural drawings, visual observations, nature of distress, collapse and investigation, limitations on investigator, tools for investigation, various NDT methods for assessing strength of distressed materials, concrete endoscopy. Investigation management, review of assimilated information, interviews and statements, evaluation and reporting, presentation of report, role of client, architect, consulting engineer and contractor

Unit 3: Structural Health Monitoring (SHM) (06 hours)
Introduction to SHM, Local and Global techniques for SHM, short and long-term monitoring, active and passive monitoring, remote and wireless SHM Techniques. Instrumentation, data acquisition, data processing for SHM, Artificial Intelligence in SHM

Unit 4: Retrofitting of Structures (06 hours)
Methods of retrofitting: moisture barrier systems, mass reduction technique, jacketing, shortcreting, Ferro cement mesh, inserting new member, base isolation. Suitability of various retrofitting

techniques for RC structures, steel structures and masonry structures and introduction to retrofitting of Historical Structures

Unit 5: FRP and Retrofitting of RC Columns (06 hours)

Fiber Reinforced Polymer (FRP), Types of FRP and their properties, advantages of FRP retrofitting, FRP retrofitting using FRP plates, FRP wrapping, FRP bars, National and International code provisions. Retrofitting of RC columns using FRP for axial confinement as per provisions of ACI 440

Unit 6: Retrofitting of RC Beams using FRP (06 hours)

Analysis and design of RC beam using FRP, Retrofitting of RC Beams using FRP for flexural strengthening, shear strengthening, Provisions of ACI 440.

Text books

01 Concrete Repair and Maintenance, P. H. Emmons and G M Sabnis, Galgotia Publication.
02 Repairs and Rehabilitation, Compilation from Indian Concrete Journals
03 Building: Structural Audit, Repairs and Restoration, Arun Kelkar, Majestic Publishing House.
04 Concrete Building Pathology, Susan Macdonald, Blackwell Publishing
05 Diagnosis and treatment of structures in Distress, R. N. Raikar, R & D Centre, (SDCPL).
06 A Handy Guide to Repairs, Rehabilitation and Waterproofing of RCC Building (Structures), Jayakumar J. Shah.

Reference books

01 ACI 440.2R-08, Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures, American Concrete Institute.
02 Xilin lu (2010), Retrofitting Design of Building Structures, Science Press, New York.
03 Strengthening and Rehabilitation of Civil Infrastructures Using Fibre-Reinforced Polymer (FRP) Composites, L. C. Hollaway and J. G. Teng, Woodhead Publishing Series in Civil and Structural Engineering
04 Maintenance, Repair & Rehabilitation & Minor Works of Building, by P C Varghese, PHI
05 Management of Deteriorating Concrete Structures, George Somerville, Taylor and Francis, Publication.
06 Durability of Cement and Cement Composites, C. L. Page, M M Page, Wood Head, Publishing.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401014 a Elective VI: TQM and MIS

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

Pre-requisites
Project management & engineering economics, construction management

Course objectives
01 Engineers with the ability to propose total quality management system in the construction projects
02 Engineers with the ability to appraise quality system standards in the construction projects
03 Engineers with the ability to choose MIS for a construction organizations

Course outcomes
On successful completion of this course, the learner will be able to,
01 Recognize quality and contribution of quality gurus for evaluation of best practices
02 Relate the functioning and application of TQM & Six Sigma in the domain of construction sector
03 Recommend ISO 9001 principles in preparation of quality manual to construction business
04 Apply management control & certification systems for construction industry
05 Choose TQM process implementation and various quality awards for construction sector
06 Propose MIS for allied fields in construction sector

Course Content

Unit 1: Construction Quality (06 hours)
Quality: various definitions and interpretation, importance of quality on a project in the context of global challenges, factors affecting quality of construction, reasons for poor quality & measures to overcome, Contribution of various quality gurus (Juran, Deming, Crossby, Ishikawa). Evolution of TQM-QC, TQC, QA, QMS, TQM, PDCA cycle

Unit 2: TQM and Six Sigma (06 hours)
TQM: Necessity, advantages, old and new 7 QC tools, quality function deployment (QFD), Six sigma: iimportance, levels, run chart and case study. Defects & it's classification in construction, measures to prevent and rectify defects and case study.

Unit 3: ISO and Quality Manual (06 hours)
Study of ISO 9001:2015 principles. Quality manual: importance, contents, documentation, importance of check-lists in achieving quality, typical checklist for concreting activity, formwork activity, steel reinforcement activity. Corrective and preventive actions, conformity and NC reports

Unit 4: Management Control and Certifications (06 hours)
Benchmarking in TQM, quality circle, categories of cost of quality, CONQAS, CIDC-CQRA certifications

Unit 5: Techniques in TQM Implementation and Awards **(06 hours)**

Five S techniques, failure mode effect analysis (FMEA), zero defects, Japanses tools and practices: JIT, KAIZEN, KANBAN, total productive maintenance, National & International quality awards- Rajeev Gandhi Award, Jamunalal Bajaj Award, Golden Peacock Award, Deming Prize, Malcolm Baldrize award

Unit 6: MIS **(06 hours)**

Introduction to management information systems (MIS), overview, definition, MIS and decision support systems, information resources, management subsystems of MIS, MIS based on management activity whether for operational control, management control, strategic control. Study of an MIS for a construction organization associated with building works.

Text Books

01 Total Quality Management, Dr. Gunmala Suri and Dr. Puja Chhabra Sharma, Biztantra
02 Quality Control and Total Quality Management, P. L. Jain- Tata McGraw Hill Publ. Company.
03 Total Quality Management, Dr. S.Rajaram and Dr. M. Sivakumar, Biztantra.
04 Total Engineering Quality Management, Sunil Sharma, Macmillan India Ltd. Publishing
05 Management Information System, James O'Brien, Tata McGraw Hill Publishing

Reference Books

01 Importance of quality on a project in the context of global challenges. Importance of quality on a project in the context of global challenges, Juran's Quality Handbook, Juran Publication.
02 Management: Principle, process and practices, by Bhat, Oxford University Press.
03 Juran's Quality Planning & Analysis, Frank Gryna, Richard Chua, Joseph Defeo, McGraw Hill Publishing.
04 Management Information Systems, Gordon B. Davis, Margrethe H. Olson, Tata McGraw Hill Publishing.
05 Total Project Management: The Indian Context, P. K. Joy, Macmillan India Ltd Publishing.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401014 b Elective VI: Advanced Transportation Engineering

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

Pre-requisites
Surveying and leveling, concrete technology and infrastructure engineering

Course objectives
01 To develop an analytical approach to urban transportation system.
02 To impart knowledge of sustainable transportation system with emphasis on non-motorized mode of transport.
03 To enable the students to design efficient pavement structure.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Analyze travel demand model and forecasting.
02 Evaluate relative importance of various modes and their capacities.
03 Design facilities required for non-motorized transportation and pedestrians.
04 Estimate basic characteristics of traffic stream and signal design.
05 Design flexible pavements.
06 Design rigid pavements and overlays.

Course Content

Unit 1: Transport System Planning (06 hours)
Transportation planning process, types of origin: destination surveys. Origin: destination matrix, travel demand forecasting, trip generation: growth factor and synthetic models, modal spilt analysis, trip distribution and route assignment analysis, transportation system management (TSM), application in comprehensive mobility plan (CMP) and detailed project report (DPR).

Unit 2: Urban Transport Technology (06 hours)
Classification: light, medium, mass and rapid transit system, introduction to intelligent transportation system (ITS) and its application for urban roads (IRC SP 110:2017), public transport policy (National and Maharashtra State), introduction to BRT, Mono rail, Metro rail, Bullet train and Hyperloop, use of drone, concept of integrated inter model transit system, freight transportation. Environmental impact assessment: EIA requirement of highway projects, procedure and guidelines.

Unit 3: Introduction to Non-Motorized Transport (NMT) (06 hours)
Introduction, NMT Systems, NMT in developed countries, data collection techniques, mobility and NMT in sustainable urban development, role of city developers, analysis of NMT, Impacts, pedestrian characteristics, pedestrian level of service, pedestrian facility design (IRC 11-2015): footpath, zebra crossing, underpass, pedestrian actuated signals, bicycle level of service, bicycle facility design.

Unit 4: Traffic Systems **(06 hours)**

Traffic Stream Models: Greenshield's model and Greenberg's logarithmic model, concept of level of service (LOS) as per highway capacity manual (HCM) and Indo-HCM**.** Concepts of delay and queuing in traffic streams, design of traffic signal by Webster's method and IRC method, overview of IRC SP: 12 – 2015, guidelines for parking facilities in urban areas.

Unit 5: Study of Flexible Pavement **(06 hours)**

Analysis and design of flexible pavement as per IRC 37: 2018 (Complete design including the use of IITPAVE), distresses in flexible pavement and recommended rectification as per IRC 82: 2015, surface unevenness and measuring road roughness as per IRC SP: 16 - 2019.

Unit 6: Rigid Pavement and Overlay 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 Traffic Engineering and Transport Planning, L R Kadiyali, Khanna Publishers.
02 Understanding Traffic System, Michel A Taylor, William Young, Peter W Bonsall.
03 Principles of Urban Transport Systems Planning, B. G. Hutchinson.
04 Principles of Transportation Engineering, Partha Chakraborty and Animesh Das.
05 Introduction to transport planning, M. J. Bruton

Reference books

01 Transport Networks, Potts Oliver (Academic Press).
02 Principles of Pavement Design, E. F. Yoder (John Wiley & Sons, lnc USA).
03 Fundamentals of Transportation Engineering, C. S. Papacostas.
04 Pavement analysis and Design, Huang Y H, Prentice Hall, Englewood Cliff, New Jersey.
05 Introduction to Transportation Engg. and Planning, Morlok E K, McGraw-Hill company.
06 Fundamentals of Traffic Flow Theory , Drew, McGraw-Hill book co.
07 A Course in Traffic Planning and Design, Saxena Subhash, Dhanpat Rai & sons,Delhi

Indian standards and handbooks

01 IRC 37-2018, Guidelines for the design of Flexible Pavement (Fourth Revision).
02 IRC 58-2015, Guidelines for the Design of Plain Jointed Rigid Pavements for Highways (Fourth Revision).
03 IRC 81-1997, Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection Technique (First Revision).
04 IRC 82-2015, Code of Practice for Maintenance of Bituminous Surfaces of Highways.
05 IRC SP 110: 2017, Application of Intelligent Transport System for Urban Roads.
06 IRC SP: 12 – 2015, Guidelines for Parking Facilities in Urban Areas (First Revision).
07 IRC 93: 1985, Guidelines on Design and Installation of Road Traffic Signals.
08 IRC SP: 16 – 2019, Guidelines on Measuring Road Roughness and Norms. (Second Revision).
09 IRC SP: 83 – 2018, Guidelines for Maintenance, Repairs & Rehabilitation of Cement Concrete Pavements.
10 Handbook of Road Technology, Lay M. G. Gorden Breach Science Pub. Newyork.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
4010 14 c Elective VI: Geo-Synthetic Engineering

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

Pre-requisites

Geotechnical Engineering, Foundation Engineering

Course objectives

01 To deal with the geo-synthetics as construction materials in civil engineering project.
02 To introduce the manufacture, behaviour and concept of geo-synthetics.
03 Applications of geo-synthetics in different civil engineering projects.

Course outcomes

On successful completion of this course, the learner will be able to,
01 Explain types of Geo-synthetic material and its application in construction industry
02 Define physical and engineering properties of geo-synthetics material
03 Describe function of geo-synthetics material and its application in geo environment engineering
04 Analyse effect of geo-synthetics in design of flexible pavements
05 Design the reinforced soil retaining structures
06 Explain mechanism of soil reinforcement to improve bearing capacity of soil

Course Content

Unit 1: Overview of Geo-synthetics (06 hours)

Types of geo-synthetics: geo-textile, geo-grid, geo-nets, geo-membranes, geo-foam, geo-composite, introduction of geo-synthetic clay liners, primary functions of each geo-synthetics material, manufacturing of geo-synthetics, raw materials used, different types of geo-synthetics manufacturing system.

Unit 2: Properties of Geo-synthetics material (06 hours)

Geo-synthetics testing, various properties of geo-synthetics, physical properties, mechanical properties, hydraulic properties and endurance properties

Unit 3: Functions of Geo-synthetics material (06 hours)

Geo-synthetics in filtration, drainage and erosion control, mechanism of filtration and drainage function and their application, design step for erosion control and re-composite drainage, application of geo-synthetics in geo environment.

Unit 4: Geo-synthetics in Pavement (06 hours)

Mechanism and concept of pavement, design of unpaved road using geo-synthetic material, giroud and Noiray method, airfield pavement design.

Unit 5: Geo-synthetics in reinforced soil retaining wall (06 hours)

Types of the facing element, construction procedure, cost, design of geo-synthetics wrap around face wall, geo-grid reinforced soil wall, geo-cell wall and gabion wall.

Unit 6: Geo-synthetics in ground improvement **(06 hours)**

Consolidation technique, prefabricated vertical drain, ground instrumentation and monitoring, design of encased stone column, bearing capacity of geo-synthetics reinforced soil system, mechanism of geo-cell reinforced sand overlaying soft clay.

Text books

01 Advanced Soil Mechanics, Das. B. M. 2008, Taylor and Fracis group, London

Reference books

01 Designing with Geo-synthetics. Vols. 1 & 2, Koerner, R. M., 6th Edition, Xlibris Corporation, USA.

02 Geo-synthetics Design and Construction Guidelines, Holtz. R. D., Christopher. B. R. and Berg. R. R. Technical Consultant, Dr. DiMaggio, U.S. Department of Transportation, Washington DC, FHWA-H1-98-038

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. July 2022
401 014 d Elective VI: Structural Design of Foundations

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

Pre-requisites
Basics of geotechnical engineering

Course objectives
01 To assess the soil condition at a given location in order to suggest suitable foundation based upon bearing capacity.
02 To study design procedure of raft foundation and Machine foundations.
03 To study design principles of pile foundation, pile caps, well and caissons foundations.
04 To have knowledge on methods of retaining structures.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Judge suitable type of shallow foundation based on the available soil category.
02 Decide suitable type of pile foundation for different soil stratum and evaluation of group capacity by formulation.
03 Design Raft foundations.
04 Design well and caissons Foundations.
05 Design different types of Machine foundations.
06 Design Retaining Structures.

Course Content

Unit 1: Shallow Foundations **(06 hours)**
Review of soil investigation, estimation of bearing capacity, settlement and depth of foundation, types of foundations and their specific applications, structural design of combined footings: strip footing, trapezoidal and strap.

Unit 2: Raft Foundation **(06 hours)**
Structural design of rafts by conventional method, principles of design of buoyancy raft and basement (no design problems), pressure relieve valves or ground/rock anchors (no design problems), concept of modulus of sub-grade reactions.

Unit 3: Pile Foundation **(06 hours)**
Types of pile foundations and their applications, estimation of load capacity of piles by static and dynamic formulae, pile load test, settlement and detailing as per IS 2911, concept of negative skin friction, piles subjected to uplift load (including under reamed piles), structural design of piles and pile caps, modulus of sub-grade reaction for laterally loaded piles.

Unit 4: Well and Caisson Foundations **(06 hours)**

Review of well and caisson foundations, structural elements of caisson and well foundations, load carrying capacity, grip length, structural design of well foundation and lateral stability, design of individual components of caisson foundation (only forces acting and design principles).

Unit 5:Machine Foundations **(06 hours)**

General requirements and design criteria, analysis and design by Barkans method, determination of coefficient of uniform elastic compression, design of a machine foundation, IS. Method of design (IS 2974).

Unit 6: Retaining walls **(06 hours)**

Types of flexible and rigid earth retention systems: counter fort, gravity, diaphragm walls, sheet pile walls, soldier piles and lagging, support systems for flexible retaining walls (struts, anchoring), construction methods, stability calculations, design of flexible and rigid retaining walls (Cantilever), types of reinforced earth (RE) walls, gabbions, soil nailing & rock bolting.

Text books

01 Soil Mechanics and Foundation Engineering, A. K. Arora, Standard Publishers
02 Soil Mechanics and Foundation Engineering, B. C. Punmia, Laxmi Publication.
03 Foundation Engineering, P. C. Varghese, PHI learning private limited
04 Principles of Foundation Engineering, Dass B. M., Thomson Learning

Reference books

01 Advanced Foundation Engineering, Murthy V. N. S., C.B.S. Publishers
02 Foundation Analysis and Design, Bowels J. E., McGraw-Hill International Book Co.
03 Foundation Design: Principles and Practice, Coduto, Donald P., Prentice Hall
04 Principles of Foundations Engineering, Braja M. Das, Thomson Asia (P) Ltd.
05 Foundation Design manual for Practicing Engineers, Nayak, N. V., Dhanpat Rai and Sons
06 Foundation Engineering Handbook, Robert W. Day, Tata McGraw- Hill Companies Inc.
07 Foundation Design and Construction, Tomlinson, M. J. and Boorman. R., ELBS Longman.

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Savitribai Phule Pune University, Pune
B E Civil (2019 pattern) w. e. f. June 2021
401014 e: Elective VI: Green Structures and Smart Cities

Teaching scheme	Credits	Examination scheme
Lectures: 3 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 To understand green structures and energy efficient materials and their impacts on sustainability
02 To describe different terminologies and engineering concepts involved in smart city.
03 To understand the importance of smart cities with available case studies from India.

Course outcomes
On successful completion of this course, the learner will be able to,
01 Students should be able to describe the importance of energy and minimization by altering the building materials.
02 Students should be able to understand the importance green construction and green rating system
03 Students should be able to introduce the applications of energy conservation and efficiency practices in buildings.
04 Students should be able to understand phases and approval involved in smart city project.
05 Students should be able to assess the national and global experience of smart cities.
06 Students should be able to understand the importance of sustainable development and current protocol of sustainable development goals.

Course contents

Unit 1: Introduction to Embodied Energy (06 hours)
Introduction to embodied energy, operational energy in building and life cycle energy, ecological foot print, bio-capacity and calculation of planet equivalent, introduction to civil engineering materials with embodied energy minimization concept and utilization

Unit 2: Green Construction Practices (06 hours)
Introduction to green construction practices, operational energy reduction and net zero building, introduction to optimization for design of building for energy efficiency, examples of optimization, introduction to radiation budget, surface water balance, effects of trees and microclimatic modification through greening, importance of rating and rating systems.

Unit 3: Building Integrated Photo Voltaic (06 hours)
Introduction to use of building integrated photo voltaic (BIPV) and other renewable energy in buildings their basic concepts and efficiency, introduction to energy conservation building code (ECBC-2017), mandaroty requirement for comfort system and control and electrical and renewable energy system, introduction to concepts of overall thermal transfer value (OTTV) etc.

Unit 4: Introduction to Smart Cities (06 hours)
Introduction to smart cities, introduction to city planning, dimensions of smart cities, phases, stages of project & their approval status, conventional Vs. smart city components, energy demand, green

approach to meet energy demand, index of Indian cities towards smartness, introduction to statistical analysis.

Unit 5: Singular-Hybrid Smart Cities (06 hours)

Conventional cities, consequences, alternative resources, reliability on predictability scale, solar options, PV and thermal; singular or hybrid, global experience of smart cities, smart cities, global standards and performance benchmarks, practice codes, India "100 smart cities" policy and mission, smart city planning and development.

Unit 6: Sustainable Smart City (06 hours)

Swachh Bharat mission and smart cities program, financing smart cities development, smart city case studies, governance of smart cities, introduction to artificial intelligence (AI) in smart cities, introduction to (sustainable development goal) SDG, the importance of SDG 11.

Text Books

01 Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition, Ross Spiegel, Dru Meadows

02 Mindful Smart Cities: Rethinking Smart Cities with Mindfulness Engineering, Shima Beigi PhD, VUB PRESS

Reference Books

01 Climate responsive architecture (A design hand book for energy efficient buildings), Arvind Krishnana, Simos Yannas, Nick Baker, S V Szokolay, McGraw hill Education, Seventh reprint.

02 Energy and the Environment, J M Fowler, McGraw Hill, New York, 2nd Edition.

03 Time-Saver Standards For Building Types, Joseph De Chiara, Michael J. Crosbie, McGraw-Hill.

04 Smart Cities: Foundations, Principles, and Applications, Houbing Song, Ravi Srinivasan, Tamim Sookoor, Wiley.

05 Beyond Smart Cities: How Cities Network, Learn and Innovate, Tim Campbell, Routledge.

IS Codes

01 Handbook on functional requirements of buildings (SP41), Bureau of Indian Standards, New Delhi, New Delhi, 1987

02 Energy Conservation Building Code (ECBC), Bureau of energy efficiency, 2017

03 Sustainable Building Design Manual- Volume I & II, TERI, 2009.

04 Green Rating for Integrated Habitat Assessment (GRIHA) guidelines

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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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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. June 2022
401 018 b Elective V: Structural Design of Bridges 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 One project on RC highway bridges which shall include: design of deck slab, longitudinal girder, cross-girder, bearings, abutment and pier. The detailing shall be shown in at least three full imperial sheets.

02 One project on railway steel bridges which shall include: design of steel trussed bridges ‘or’ the design of plate girder bridges. The detailing shall be shown in at least two full imperial sheets.

03 Report of at least two site visits covering the contents of the syllabus.

Note: 1. The projects can be done using suitable finite element and drafting software.

2. The term work can be prepared in a group of not more than four students in a group.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 c Elective V: Irrigation and Drainage 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 Assignment to summarize types of irrigation methods and application of artificial intelligence techniques in irrigation and drainage.
02 Assignment on evapotranspiration estimation using Penman's equation or FAO Penman-Monteith equation. *(Hand calculations).*
03 Assignment on solution of Assignment 2 using computer programme/spreadsheet.
04 Assignment on design of drip irrigation system.
05 Assignment on design of sprinkler irrigation system.
06 Assignment based on Unit 5. (Min. 6 questions).
07 Assignment on design of surface drainage system and design of subsurface drainage system
08 Assignment on use of **CropWat** software to determine crop water requirement and irrigation scheduling.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 d Elective V: Design of Precast and Composite Structures Lab

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

Term Work

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

01 Assignment one at least five questions on Unit 1 covering all the topics listed in syllabus.
02 Assignment two at least five questions on Unit 2 covering all the topics listed in syllabus.
03 Full imperial drawing sheet: detailing of any one design problem from Unit 3 or Unit 4
04 Full imperial drawing sheet: detailing of any one design problem from Unit 5 or Unit 6
05 Report on site visit (Precast or Composite Structures) covering the contents of the syllabus mentioned above.
06 Analysis and design of composite building using any suitable FE based software.

Note: The group size should not be more than five students and each group should have different design data.

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

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

Term Work

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

01 Calculating the electricity bill of upper middle class family that uses various electrical appliances.
02 Determination of power output for a run of river plant with and without pondage.
03 Justification of economics of pumped storage plants.
04 Design of Kaplan / Francis / Pelton turbine.
05 Design of straight conical draft tube.
06 Use of any software to calculate water hammer pressure.
07 Study of any hydropower project.
08 Design of intake of a hydropower plant with neat sketch**:** Design of settling basin of a hydropower plant with neat sketch.
09 Hydraulic Design of Forebay and preparation of plan and longitudinal sections **::** Hydraulic Design of Surge Tank and preparation of plan and vertical sections **::** Estimation of hydrodynamic pressure and steel thickness of penstock.
10 Report based on visit to any micro/small/mega hydropower project.

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Savitribai Phule Pune University, Pune
B. E. Civil (2019 Pattern) w. e. f. June 2022
401 018 f Elective V: Structural Audit and Retrofitting of Structures Lab

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

Term Work

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

01 Report on various repair materials available in the market
02 Conduction of Visual observation of any damaged structure and preparation of report
03 Determination of compressive strength of polymer modified mortar
04 Determination of compressive strength of polymer modified concrete
05 Non-destructive test on concrete (any one)
06 Assignment on materials and methods of retrofitting.
07 Demonstration of Moisture barrier coatings and membranes
08 Assignment on Retrofitting of RC Beams using FRP
09 Assignment on Retrofitting of RC Columns using FRP
10 Site Visit to any structure where repair/retrofitting work is in progress
11 Conduction of Structural Audit of any nearby structure and preparation of detailed report

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401019Audit Course II a: Social Responsibility

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

Pre-requisites
None

Course objectives
01 Develop understanding of social responsibility
02 Understand the International framework for Social Responsibility
03 Know the drivers of social responsibility in India
04 Identify the key stakeholders of social responsibility

Course outcomes
On successful completion of this course, the learner will be able to:
01 Develop understanding of social responsibility
02 Learn the International framework for Social Responsibility
03 Know the drivers of social responsibility in India
04 Identify the key stakeholders of social responsibility

Course Contents

Unit 1: Introduction to social responsibility meaning and definition, history of social responsibility, concepts of charity, social philanthropy, citizenship, sustainability and stakeholder management, environmental aspects of social responsibility. International framework for social responsibility: millennium development goals, sustainable development goals, relationship between corporate social responsibility and millennium development goals, OECD corporate social responsibility policy tool.

Unit 2: Drivers of social responsibility in India: market based pressure and incentives, civil society pressure, the regulatory environment in India counter trends, review of current trends and opportunities in social responsibility, review of successful corporate initiatives and challenges of social responsibility. Identifying key stakeholders of social responsibility: role of public sector in corporate, government programs, non-profit and local self-governance in implementing social responsibility, global compact self-assessment tool, national voluntary guidelines by govt. of india, roles and responsibilities of corporate foundations.

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Reference books

01 Strategic Corporate Social Responsibility: William B. Werther Jr. and David Chandler, Stakeholders in a Global Environment, Second Edition, Sage Publications.
02 Corporate Social Responsibility in India: Sanjay K Agarwal, Sage Publications.
03 Corporate Social Responsibility: An Ethical Approach: Mark S. Schwartz, Broadview Press.

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Savitribai Phule Pune University, Pune
B E Civil (2019 Pattern) w. e. f. July 2022
401019 Audit Course II b: Human Rights

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

Pre-requisites
None

Course objectives
01 Understand the concept of Human rights and Human rights Movement
02 Understand the Human rights and Indian Constitution
03 Gather Knowledge about Human Rights of the Different Sections and contemporary issues
04 Gather knowledge about international scene towards human rights with reference to engineering Industry

Course outcomes
On successful completion of this course, the learner will be able to,
01 Gather Knowledge about Human rights and Human rights Movement
02 Develop understanding of Human rights and Indian Constitution
03 Discuss Human Rights of the Different Sections and contemporary issues
04 Discuss International scenario towards human rights with reference to engineering Industry

Course Content

Unit 1: Human rights: concept, development, evolution-philosophical, sociological and political debates, benchmarks of human rights movement. Human rights and the Indian constitution: constitutional framework, fundamental rights and duties, directive principles of state policy, welfare state and welfare schemes. Human rights and state mechanisms: police and human rights, judiciary and human rights, prisons and human rights, national and state human rights commissions.

Unit 2: Human rights of the different sections and contemporary issues: unorganized sector, right to environment, particularly industrial sectors of civil engineering and mechanical engineering, globalization and human rights, right to development, citizens' role and civil society: social movements and non-governmental organizations, public interest litigation. Role of non-government organizations in implementation of human rights: right to information. Human rights and the international scene: primary information with reference to engineering. Industry: UN documents, International mechanisms (UN & Regional), International criminal court.

Reference Books

01 Human Rights in India- A Mapping: Usha Ramanathan.
Free download from http://www.ielrc.org/content/w0103.pdf
02 Introduction to International Humanitarian Law by Curtis F. J. Doebbler - CD Publishing
03 Study material on UNESCO, UNICEF web site
04 http://www.unipune.ac.in/pdf_files/final%20book_03042012.pdf
05 http://eclm.unipune.ac.in/Human rights

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