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: 50 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 Ideal fluid flow (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: 50 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: 50 Marks

Term Work

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

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

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

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

Term Work

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

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

Savitribai Phule Pune University, Pune
TE Civil (2019 Pattern) w. e. f. June 2021
301010 e: Elective I: Matrix Methods of Structural Analysis Lab

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

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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.

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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