Vidya Pratishthan's
Kamalnayan Bajaj Institute of Engineering and Technology,
Baramati
(An Autonomous Institute)

Board of Studies

Department of Civil Engineering

Syllabus

T. Y. B. Tech
Civil Engineering

(2024 Pattern w.e.f. AY:2026-2027)

SEMESTER V

Course Type	Course Code	Subject	Teaching Scheme			Examination Scheme							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	CE24301 TH	Design of Steel Structures	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	CE24301 PR	Design of Steel Structures	-	2	-	-	-	-	-	-	30	30	-	1		
PCC	CE24302 TH	Environmental Engineering	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	CE24302 PR	Environmental Engineering	-	2	-	-	-	-	-	30	-	30	-	1	-	
PCC	CE24303 TH	Transportation Engineering	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PCC	CE24303 PR	Transportation Engineering	-	2	-	-	-	-	-	-	30	30	-	1		
PEC	XX24304 TH	Programme Elective Course	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PEC	XX24304 PR	Programme Elective Course	-	2	-	-	-	-	-	-	30	30	-	1		
MDM	MD240X XTH	Multi-disciplinary minor	3	-	-	10	30	60	-	-	-	100	3	-	-	4
MDM	MD240X XPR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
VSEC	CE24305 PR	Civil Engineering Software Lab II	-	2	-	-	-	-	-	30	-	30	-	1	-	2
VSEC	CE24305 TUT	Civil Engineering Software Lab II	-	-	1	-	-	-	40	-	-	40	-	-	1	
VEC	HS2430 1AU	Constitution of India	1	-	-	-	-	GR	-	-	-	GR	-	-	-	AU
Total			14	12	1	50	120	300	70	60	90	690	14	7	-	21

List of Program Electives

Code	Program Elective Course	Code	Program Elective Course
CE24304A	Advanced Surveying	CE24304D	Air Pollution and Control
CE24304B	Project Management and Economics	CE24304E	Advanced Concrete Technology
CE24304C	Advanced Geotechnical Engineering		

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Academic Coordinator

Dr. C. B. Nayak
Head of Department

Dr. S. M. Bhosle
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Dr. A. H. Kolekar
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Dr. S. B. Lande
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Id No./PU/GN/Engg/152/2000
PUNE (MS.)

SEMESTER-VI

Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits			
			TH	PR	TUT	CAA	ISE	ESE	TW	PR	OR	Total	TH	PR	TUT	Total
PCC	CE24311TH	Structure Design for Reinforced Concrete	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PCC	CE24311PR	Structure Design for Reinforced Concrete	-	2	-	-	-	-	-	-	30	30	-	1	-	
PCC	CE24312TH	Hydrology & Irrigation Engineering	2	-	-	10	-	60	-	-	-	70	2	-	-	3
PCC	CE24312PR	Hydrology & Irrigation Engineering	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	CE24313XTH	Program Elective I Course	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PEC	CE24313XPR	Program Elective I Course	-	2	-	-	-	-	-	-	30	30	-	1	-	
PEC	CE24314XTH	Program Elective II Course	3	-	-	10	30	60	-	-	-	100	3	-	-	4
PEC	CE24314XPR	Program Elective II Course	-	2	-	-	-	-	-	-	30	30	-	1	-	
MDM	MD240XXTH	Multi-disciplinary minor	2	-	-	10	-	60	-	-	-	70	2	-	-	3
MDM	MD240XXPR	Multi-disciplinary minor	-	2	-	-	-	-	30	-	-	30	-	1	-	
OE	OE240XXTH	Open Elective	3	-	-	10	30	60	-	-	-	100	3	-	-	3
VEC	HS24311AU	Democracy, Election and Governance	1	-	-	-	-	GR	-	-	-	GR	-	-	-	AU
Total			16	10	-	70	120	360	30	0	120	690	16	5	-	21

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List of Program Elective Course

Code	Program Elective I Course	Code	Program Elective II Course
CE24313A	Construction Management and Finance	CE24314A	Design of Prestressed Concrete Structures
CE24313B	Formwork and Plumbing Engineering	CE24314B	Waste Water Engineering
CE24313C	Airport and Bridge Engineering	CE24314C	Earthquake Engineering
CE24313D	Structural Design of Bridges	CE24314D	Hydro Power Engineering
CE24313E	Advanced Engineering Geology with Rock Mechanics	CE24314E	Solid Waste management
Code	**Program Elective I Course**	**Code**	**Program Elective II Course**
CE24313A	Construction Management and Finance	CE24314A	Design of Prestressed Concrete Structures
CE24313B	Formwork and Plumbing Engineering	CE24314B	Waste Water Engineering
CE24313C	Airport and Bridge Engineering	CE24314C	Earthquake Engineering
CE24313D	Structural Design of Bridges	CE24314D	Hydro Power Engineering
CE24313E	Advanced Engineering Geology with Rock Mechanics	CE24314E	Solid Waste management

List of Multi-Disciplinary Minor and Open Elective

Code	Multi-Disciplinary Minor	Code	Open Elective
AI24051	AI & Machine Learning	OE24001	Digital Marketing (MKCL)
AI24052	Data Science	OE24002	Professional Leadership
AI24053	Generative AI	OE24003	Organizational Behaviour
CO24051	Cloud Computing	OE24004	Industrial Management
CO24052	High Performance Computing	OE24005	Disaster Management
CO24053	Computer Graphics & Gaming	OE24006	Energy Economic & Management
IT24051	Cyber Security	OE24007	Operation Research
IT24052	Full Stack development	OE24008	Intellectual Property Rights
ET24051	Embedded Systems	OE24009	Cyber Laws
ET24052	Drone Technology	OE24010	Bioinformatics
ET24053	Internet of Things	OE24011	Biotechnology
CE24051	Waste Management	OE24012	International Relations
CE24052	Green Building & Smart Cities	OE24013	Universal Human Values
ME24051	Introduction to 3D Printing Technologies	OE24014	Education Technology
ME24052	Introduction to Robotics & Automation	OE24015	Design Thinking
EL24051	Fundamentals of Solar Technology	OE24016	Accounting & Finance
EL24052	Industrial Automation	OE24017	Sustainability & Climate Change
GS24051	Nanotechnology	OE24018	Agriculture Technology
GS24052	Linear Algebra & statistics	OE24019	Architectural Technology

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CE24301 - Design of Steel Structures

Teaching Scheme:	Credits	Examination Scheme:
TH : 0 3 Hrs./week	03	CAA: 10 Marks
		ISE: 30 Marks
		ESE: 60 Marks

Prerequisite:

Fundamentals of Engineering Mechanics, Mechanics of Materials and Structural Analysis

Course Objectives:

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

Course Outcomes:

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

CO1: Understand the fundamentals of structural steel fasteners and connections

CO2: Learn the analysis and design of tension and compression members.

CO3: Analyze and design steel column and column bases.

CO4: Analyze and design the flexural members.

CO5: Analyze and design industrial truss and gantry girder.

CO6: Analyze and design of welded plate girder and understand the concept of Pre-Engineered Building structures (PEB).

Course Contents

Unit I: Design Philosophy and Connections
(07 Hours)

Steel as a structural material, various grades of structural steel, properties, various rolled steel sections and their properties, Introduction to IS 800:2007,808,816,875 etc, Design philosophies, Plate(Local) buckling, Classification of cross-sections(flexure). Structural Steel Fasteners: Introduction, Behavior of bolted and welded connections (types, designations, properties, permissible stresses), failure of bolted and welded joints. Strength of bolt and strength of weld, Efficiency of joints, Design of simple, bolted and welded connections.

Unit II: Design of Tension and Compression Members
(07Hours)

Design of axially loaded members (a) Tension members: Introduction, Net area, Shear-lag and block shear.

(b) Compression members: Introduction, Euler's buckling theory, Classification of cross- sections (buckling), Imperfection factor.

Unit III: Design of Columns and Column Bases
(07 Hours)

Design of columns: Introduction, Design of axially loaded rolled sections, built up columns, laced and battened columns, Column base: slab base and gusseted base under axial loads.

Unit IV: Design of Flexural Members
(06 Hours)

Design of simple beams: Introduction, Flexural behavior of beams which does not undergo lateral buckling, Flexural behavior of beams which undergo lateral buckling, Shear behavior, Web buckling and Crippling, Design strength in bending, Design strength in shear, Limit state serviceability–Deflection.

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

Analysis of roof truss of an industrial building: Introduction to different components of industrial shed, types of trusses, assessment member forces under various loads (dead load, live load and wind load), design of members of a truss, design of purlin. Design of gantry girder: selection and design of cross section, check for moment capacity, buckling resistance, bi-axial bending, serviceability and fatigue strength.

Unit IV: Design of Welded Plate Girder and PEB structures (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.

Introduction to Pre-Engineered Building (PEB) structures.

Books & Other Resources:

Text books:

1. Limit State Design of Steel Structures, S K Duggal, Tata McGraw Hill Education, New Delhi.
2. Design of Steel Structure by Limit State Method as per IS: 800- 2007, Bhavikatti S S, I. K. International publishing house, New Delhi.
3. Design of Steel Structures, K. S. Sai Ram, Pearson, New Delhi

Reference books:

1. Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi
2. Limit State Design in Structural Steel, M. R. Shiyekar, PHI, Delhi
3. Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.
4. Limit State Design of Steel Structure, Ramchandra & Gehlot, Scientific Publishers, Pune
5. Analysis and Design: Practice of Steel Structures, Karuna Ghosh, PHI Learning Pvt. Ltd. Delhi
6. Limit State Design of Steel Structure, V L Shah & Gore, Structures Publication, Pune

IS Codes

1. IS 800-2007: Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi
2. IS 808-1989: Dimensions for hot rolled steel beam, column, channel and angle sections, Bureau of Indian Standards, New Delhi
3. 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
4. SP-6(1) and 6(6): ISI handbook for Structural Engineers, Bureau of Indian Standards, New Delhi

Dr. S. G. Mosstede

Design of Steel Structures
CE24301PR

PR: 0 2 Hrs./Week **Credits: 01** **OR: 30 Marks**

Laboratory Experiments/Assignments

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

1. Four full imperial size hand drawn drawing sheets/AutoCAD consists of steel structural detailing of 16 sketches based on the syllabus.
2. 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.
3. Compulsory two site visits based on industrial steel structure and welded plate girder. Report should contain structural details with sketches.

Activity

An activity can be designed such as to enhance students learning experience. The students need to submit assignment on each unit as part of activity.

Dr S.S. Mosthole

CE24302 - Environmental Engineering

Teaching Scheme	Credits: 04	Examination Scheme
Lectures: 3 hrs./week	Theory: 03	Activity : 10 Marks
Practical: 2 hrs./week	Practical: 01	In-semester : 30 Marks
		End semester: 60 Marks
		PR : 30 Marks

Prerequisite: Basics of Chemistry for Environmental Engineering.

Course Objectives:

1. To make students understand importance of water infrastructure.
2. To discuss the principles of water treatment plant and layout.
3. To inculcate and impart design principles of WTP.
4. To discuss the impacts of air and noise pollution.

Course Outcomes:

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

1. Identify water sources, estimate water requirement for various sectors.
2. Design aeration and sedimentation units of WTP.
3. Design filtration unit of WTP.
4. Understand and compare different disinfection and advanced water treatment methods.
5. Analyze water distribution system.
6. Understand the effects of air and noise pollution.

Course Contents

Unit I: Sources of Water, Quality and Quantity of Water **(07 Hours)**

Sources of water: Surface water, Ground water, Infiltration galleries, Intake works, functions, types

Water Quality: Impurities in water: Turbidity, pH, Chlorides, Hardness, Residual Chlorine, Fluoride, MPN, Significance, water quality standards

Water Demand: Water demand for domestic purposes, Fire demand, Per capita demand, Factors affecting consumption, Fluctuation in demand: Design period for water supply components, Population forecast: Arithmetical increase, Incremental increase, Geometrical increase, and Logistic curve methods.

Unit II: Aeration, Sedimentation aided with Coagulation **(06 Hours)**

Water Treatment: Flow diagram of conventional WTP; Aeration: Principle, Purpose, Design of cascade aerator; Coagulation and Flocculation: Principle of coagulation, coagulants, quantity of coagulants, concept of mean velocity gradient and power consumption, design of flocculation chamber, Sedimentation: General equation for settling of discrete particles, plain settling tank, tube settler, design of settling tank, design of clariflocculator.

Unit III: Filtration of Water **(07 Hours)**

Filtration: Theory of filtration, mechanism of filtration, filter media, rapid and slow sand filters, number of filter units, rate of filtration, under drainage system, backwashing, negative head,

Ravindra
DR R T Patil

operation and cleaning, design of slow and rapid sand filters, design of under drainage system, Pressure filter.

Unit IV: Disinfection, Advanced Water Treatment Methods **(06 Hours)**

Disinfection: Objectives, methods of disinfection, chlorination: Free and combined chlorine, residual chlorine, effect of pH, bleaching powder, types of chlorination, pre-chlorination, post-chlorination, break point chlorination, super chlorination.

Advanced Treatments: Softening: Lime soda, quantity of lime and soda, Ion exchange, Reverse Osmosis, Electrodialysis, Fluoridation and De-fluoridation, Desalination. Water softeners and purifiers for individual houses and apartments.

Unit V: Water Distribution System **(07 Hours)**

Distribution system: Types of distribution system: Continuous and intermittent supply systems, gravity, pumping and combined systems; Layout of distribution system: dead end, grid iron, circular and radial systems; Major Losses & Minor Losses, Analysis of distribution system: Hardy Cross method, Service Reservoirs: elevated service reservoir, balancing reservoir, necessity, location, capacity calculation by Mass curve method.

Unit VI: Introduction to Noise and Air Pollution **(06 Hours)**

Noise Pollution: Sound measurements – Sound pressure, intensity, sound pressure level, loudness, equivalent noise level and cumulative noise level.

Air Pollution: Atmospheric stability, mixing heights, meteorological parameters, air pollution control mechanisms, equipment for particulate contaminants. principle and working of settling chamber, cyclone, fabric filter, electrostatic precipitator (ESP), gaseous contaminants control by adsorption and absorption technique.

Books & Other Resources:

Text Books:

1. Water supply and Sanitary Engineering, S. K. Hussain, 3rd edition, CBS Publishers, New Delhi, 2017.
2. Water Supply & Sanitary Engineering, G. S. Birdie, , Dhanpat Rai & Sons, New Delhi, 2010.
3. Water and Waste water Technology, Hammer M.J., Prentice-Hall of India Pvt Ltd, seventh edition, 2012.
4. Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd.

Reference Books

1. Environmental Engineering, Peavy and Rowe, McGraw Hill Publications.
2. Optimal Design of Water Distribution Networks, P. R. Bhave, Narosa Publishing

Dr. R. J. Patil

House.

3. Water Supply Engineering, Harold Eaton Babbit & James Joseph Doland, Tata McGraw Hill.

Laboratory Experiments: Term work consist of following experiments and site visit report. Note: Perform any 8 experiments from Sr. No. 1 to 10 and Sr. No. 11 to 13 are compulsory. Practical Examination is based on term work.

1. Determination of pH of water sample.
2. Determination of Alkalinity of water sample.
3. Determination of Turbidity of water sample.
4. Determination of Hardness of water sample.
5. Determination of chlorides of water sample.
6. Determination of optimum dose of coagulant by Jar Test.
7. Determination of Most Probable Number of water sample.
8. Determination of Sodium, Magnesium and Potassium using Flame Photometer.
9. Determination of Fluoride in water.
10. Determination of Iron in water.
11. Study of water intake structures.
12. Designs of conventional water treatment plant using program/software/excel spread sheet.
13. Field visit to Water treatment plant.

Activity: Assignments for each unit.

Dr. R. J. Patil

Course Name with Code: Transportation Engineering (CE24303TH)

Teaching Scheme: TH: 2 Hrs. / week
PR: 2 Hrs. / week **Credits 3** **Examination Scheme:**
Activity: 10 Marks
End semester: 60 Marks
OR: 30

Prerequisite:
Concrete Technology, Construction Materials, Geotechnical Engineering and Surveying.

Course Objectives: Students should have the ability to:
1. Learn the principles and practices of transportation planning.
2. Describe traffic studies, their analysis, and interpretation.
3. Understand the geometric design of cross-sectional elements of pavements.
4. Study the properties, testing procedures of highway materials and design procedure for flexible and rigid pavements.

Course Outcomes: students will be able to
CO1: Understand the principles and practices of transportation planning.
CO2: Demonstrate knowledge of traffic studies, analysis, and their interpretation.
CO3: Design geometric elements of road pavements.
CO4: Evaluate the properties of highway materials and design of road pavements.

Course Contents

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

Unit II: Traffic Engineering and Control (06 Hours)
Traffic characteristics, traffic engineering studies, traffic flow and capacity, traffic control devices (signs, signals, islands and road markings), accident studies, types of road intersections, parking studies and highway lighting.

Unit III: Geometric Design of Highways (07 Hours)
Introduction to geometric design, highway cross section elements, sight distance, design of horizontal alignment, basic problems of horizontal alignment, design of vertical alignment and simple problems related to vertical alignment, design of intersections and simple problems on intersection design.

Unit IV: Pavement Materials (07 Hours)
Materials for highway construction: Types of materials- soil subgrade, aggregates and bituminous binders. Bituminous materials: Bitumen, modified bitumen, emulsions and cutbacks; overview of polymer modified bitumen, crumb rubber modified bitumen and foamed bitumen. Introduction to the pavement types; design methodology for Flexible and Rigid pavement as per guidelines based on IRC 37-2018 and IRC 58-2015.

Text Books:

1. Highway Engineering, S. K. Khanna, C. E. G. Justo and A. Veeraragavan, Nem Chand and Brothers.
2. Principles and Practices of Highway Engineering, Dr. L. R. Kadiyali, Khanna Publishers Delhi.
3. Principles of Highway Engineering and Traffic Analysis (4th Edition), F. L. Mannering and Scott S. Washburn, Wiley India.
4. Highway and Bridge Engineering, B. L. Gupta and Amit Gupta, Standard publishers Distributors.
5. Principles of Railway Engineering, Rangwala, Charotar publication.

Reference Books:

1. A Course in Highway Engineering, S. P. Bindra, Dhanpat Rai and Sons.
2. Principles of Transportation Engineering, G. V. Rao, Tata MacGraw Hill Publication.
3. Highway Engineering, Rangawala, Charotar publishing House.
4. Principles of Transportation Engineering, Partha Chakraborty and Animesh Das, Prentice Hall of India Pvt. Ltd.
5. Railway Engineering, M. M. Agarwal.Indian Standards and Handbooks:

Indian Standards and Handbooks:

1. IS 1201 to 1220 - 1978, IS 73, IS 2386 part I to V.
2. IRC 58 - 2015, IRC 37 - 2018.
3. Specifications for Road and Bridge works (MORTH) - IRC, New Delhi.
4. Handbook of Road Technology, Lay M. G., Gorden Breach Science, Newyork.
5. Civil Engineering Handbook, Khanna S. K

Course Name with Code: Transportation Engineering (CE24303PR)

Transportation Engineering Lab

The oral examination will be based on the following term work.

A. The practical consists of three parts:

I. Tests on Aggregate (Any Five)

1. Aggregate Impact Value Test.
2. Aggregate Crushing Strength Test.

3. Los Angeles Abrasion Test.

4. Shape Test (Flakiness Index and Elongation Index).

5. Specific Gravity and Water Absorption Test by basket method.

6. Stripping Value Test.

7. Soundness Test.

II. Tests on Bitumen (Any Five)

1. Penetration Test.

2. Ductility Test.

3. Softening Point Test.

4. Flash Point and Fire Point Test.

5. Bitumen Extraction Test.

6. Viscosity Test (Tar Viscometer).

7. Specific Gravity Test.

III. Tests on Aggregate and Bitumen Combination

1. Demonstration of Marshall Stability Test.

B. Technical visits

1. Site Visit Report: Road Construction Project.

2. Site Visit Report: Hot Mix Plant.

Activity: Assignments for each unit.

CE24304A – Advanced Surveying

Teaching Scheme:	**Credits: 4**	**Examination Scheme:**
TH: 3 Hrs./week	**Theory: 3**	**CAA: 10 Marks**
		In semester: 30 Marks
		End Semester: 60 Marks
PR: 2 Hrs./week	**Practical: 1**	**OR: 30 Marks**

Prerequisite:

1. Basic introduction to Civil Engineering field and Engineering Mathematics.

Course Objectives:

1. To understand the advanced surveying techniques and instruments.
2. To interpret the advanced surveying measurements.
3. To create accurate and detailed maps of the terrain using aerial mapping.

Course Outcomes: After Completion of course students will be able to

CO1: Recognize the concept of triangulation for fixing the ground control points.

CO2: Differentiate most probable values for different measurement and adjust those in a given figure.

CO3: Summarize the concepts of astronomical and hydrographic surveying.

CO4: Demonstrate the use of aerial photographs for mapping.

CO5: Analyse use of modern surveying instruments in the field.

CO6: Execute GPS and the associated software for different applications in Civil Engineering.

Course Contents

Unit: Geodetic Surveying and Trigonometric Levelling **07 Hours**

a) 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.

b) Trigonometric levelling: terrestrial refraction, angular corrections for curvature and refraction, axis signal correction, determination of difference in elevation by single observation and reciprocal observations.

Unit 2: 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 3: Astronomical and Hydrographic Survey **07 Hours**

a) 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.

b) Hydrographic surveying: objectives of hydrographic survey, shore line and river survey, soundings: equipment's to measure sounding, methods to locate sounding, three-point problem and its solution (analytical, mechanical and graphical), determination of MSL using GPS.

Unit 4: 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 5: Modern Surveying Instruments and Techniques **07 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 6: 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.

Books & Other Resources:

Textbooks

1. Surveying and Leveling - Part-II and III, T. P. Kanetkar and S. V. Kulkarni, Pune Vidyarthi Griha Prakashan, Pune.
2. Surveying Vol. II, S.K. Duggal, Tata McGraw Hill Publishing Company Ltd. New Delhi.

Reference Books

1. Advanced Surveying: Total Station, GPS, GIS & Remote Sensing, Satheesh Gopi, 2/e, Pearson Education, Chennai.
2. Surveying Vol. II & III, B C Punmia, Laxmi Publications, New Delhi.
3. Surveying Vol. II & III, K R Arora, Standard book house, New Delhi.
4. Surveying and Leveling, R Subramanian, Second edition, Oxford University Press, New Delhi.
5. Remote Sensing and Geographical Information Systems, Anji Reddy, BS Publications, Hyderabad.

For Oral students have to complete following practical/assignments.

a) Perform any 5 Practical's out of 1 to 7 and Any 01 project:

1. Measurement of vertical angles using 1" theodolite and digital theodolite.
2. Solution of three-point problem using analytical and graphical method.
3. Measuring the height of a tower using total station.
4. Setting up stakes for marking the foundation of a building on ground using total station.
5. Measurement of distances, angles, gradient and distance between two inaccessible points using total station.
6. Demonstration of the use of unmanned aerial vehicle (UAV).
7. Measuring the GPS coordinates of ground control points in a mapping survey using any GNSS system.

b) Projects: (Minimum One)

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

Activity (CAA):

Students shall complete one assignment for each of the six units as mandatory requirement under this academic activity.

Dr. S. B. Wakle.

CE24304B- Project Management and Economics

Teaching Scheme:	Credits	Examination Scheme:
TH: 3 Hrs. / week		CAA : 10 Marks
PR: 2 Hrs. / week	4	In-semester : 30 Marks
		End semester : 60 Marks
		OR : 30 Marks

Prerequisite:

Fundamentals of management, Indian construction industry, Economics.

Course Objectives: Students should have the ability to:

1. Describe the various concepts involved in project management.
2. Explain scientific methods of planning and management.
3. Segregate the materials as per their annual usage and explain process to find production rate of construction equipment.
4. Demonstrates methods of manpower planning and use various project monitoring methods.
5. Discuss engineering economics and its applications in construction.
6. Differentiate and use methods of project selection to select best project.

Course Outcomes: Students will be able to

CO1: Describe project life cycle and the domains of Project Management.

CO2: Explain networking methods and their applications in planning and management.

CO3: Categorize the materials as per their annual usage and also calculate production rate of construction equipment.

CO4: Demonstrates resource allocation techniques and apply it for manpower planning.

CO5: Understand the economic terms, laws and prepare balance sheet along with profit and loss account statement.

CO6: Apply the methods of project selection and recommend the best economical project.

Course Contents

Unit I: Introduction to Project management **(06 Hours)**

Importance, objectives & functions of management, principles of management, categories of project, project failure, project life cycle concept and cost components, project management book of knowledge (PMBOK) -different domain areas, project management institute and certified project management professionals (PMP). Importance of organizational structure in management, authority and responsibility relationship.

Unit II: Project planning & scheduling **(07 Hours)**

WBS – work breakdown structure, gantt bar chart & its limitations, mile stone chart, network planning, network analysis, C.PM., activity on arrow (A.O.A.), critical path and type of floats, precedence network analysis (A.O.N), types of precedence relationship, PERT analysis

Unit III: Project resources and Site planning **(06 Hours)**

Objectives of materials management – primary and secondary, material procurement procedures , record keeping ,use of excel sheets, ERP software, inventory control- ABC analysis, EOQ, introduction to equipment management -productivity studies, Site layout and planning, safety norms- measures and precautions on site, implementation of safety programs.

Unit IV: Project monitoring and control **(07 Hours)**

Resource allocation – resource smoothening and leveling, network crashing- time- cost-resource optimization, project monitoring methods, updating and earned value analysis, introduction to use of project management software's-MS project / primavera.

Unit V: Project economics **(06Hours)**

Introduction to project economics- definition, principles, importance in construction industry, difference between cost, value, price, rent, simple and compound interest, profit, cash flow diagram, annuities and its types, demand and supply curve, law of diminishing marginal utility, law of substitution, concept of time value of money, importance of economics in construction industry, assets, liabilities ,balance sheet, profit and loss account

Unit VI: Project appraisal **(07 Hours)**

Types of appraisals such as political, social, environmental, techno-legal, financial and economical, criteria for project selection - benefit - cost analysis, NPV, IRR, ARR, pay-back period, break even analysis, study of project feasibility report and detailed project report (DPR), role of project management consultants.

Text Books:

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

Reference Books:

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

Project Management and Economics Lab.-

Laboratory Experiments/Assignments (Perform Any 8 Out of 10, Expt. 7 is compulsory)

The term/lab. work shall consist of a journal including the exercises and activity to be conducted on the following contents. **Oral** is based on the above syllabus and term work completed.

1. Study project management domains and project life cycle through a case study
2. Preparation of work breakdown structure of any construction industry and report writing.
3. Visit to the shops and collect information about the different construction materials, chemicals, trade names, costs, applications- report writing.
4. Understand concept of productivity and calculate the production rate of any construction equipment available on the site.
5. Prepare site layout of any construction site you visited, suggest ideal site layout to it.
6. Exercises on resource smoothing /levelling, updating and on earned value analysis.
7. Planning and scheduling for a small project with minimum 25 activities using any software.
8. Study a balance sheet of any construction company and conduct its analysis.
9. Exercise on project economics.
10. Exercise on selection of best economical project by using project selection methods.

CAA:

Students have to submit assignments for each unit as a part of continuous assessment activities (CAA).

Course Code – Advanced Geotechnical Engineering (CE24304C)

Teaching Scheme:	Credits: 4	Examination Scheme:
TH:3 Hrs./week	Theory: 3	CAA: 10 Marks In semester:30 Marks End Semester: 60 Marks
PR: 2 Hrs./week	Practical: 1	OR: 30Marks

Prerequisite:

1. Fundamentals of Engineering Mechanics
2. Fundamentals of Fluid Mechanics
3. Fundamentals of Geotechnical Engineering

Course Objectives:

1. To learn classification of soil, soil structure, earth pressure on retaining structures and design of retaining structures.
2. To study triaxial test and stress path.
3. To study methods of soil stabilization and different ground improvement techniques.

Course Outcomes:

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

CO1: Classify the soil and understand the soil structure.
CO2: Calculate lateral pressure on retaining structure and carry out design of retaining structure.
CO3: Interpret the results of triaxial test under different drainage conditions.
CO4: Draw the stress path for different conditions.
CO5: Select and implement soil stabilization techniques based on field conditions.
CO6: Explain different ground improvement techniques and its suitability.

Course Contents

Unit I: Soil Classification, Soil Structure and Clay Minerals (07 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 uses AASHTO, USCS, BIS and textural classification systems, clay minerals, clay water relations clay particle interaction, soil structure and fabric, granular soil fabric

Unit II: Earth Pressure Theory and Design of Earth Retaining Structures (07 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 wall, reinforced Earth retaining wall, general principles concepts and mechanism of reinforced earth

Unit III: Shear Strength of Soil (07 Hours)

Shear strength of clay soils: 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 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, stress changes below foundation and near retaining wall

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

Soil stabilization: Introduction, objectives, factors affecting stabilization of soil, 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 IV: Ground Improvement **(06 Hours)**

In-situ ground improvement: Introduction, Objectives, necessity, methods - compaction piles, dynamic loads, explosion sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibro-floatation without numerical

Books & Other Resources:

Text books:

1. B. C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publishing Co., New Delhi.
2. Gopal Ranjan and A. S. Rao, "Basic and Applied Soil Mechanics", New Age Publication.
3. Shashi K. Gulati and Manoj Datta, "Geotechnical Engineering", Tata Mc-Graw Hill.

Reference books:

1. Joseph E Bowles, "Physical and Geotechnical Properties of Soil", McGraw Hill.
2. Braj M. Das, "Principles of Geotechnical Engineering", Cengage Learning.
3. Braja Mohan Das, "Advance Soil Mechanics", Tata Mc-Graw Hill.
4. Joseph E Bowles, "Foundation Analysis and Design", McGraw Hill.
5. Monfred R. Housmann, "Engineering Principles of Ground Modification", Mc Graw Hill Publishing co.
6. P. Purushothama Raj, "Ground Improvement Techniques", Lakshmi Publications, New Delhi.

The term work shall consist of a journal giving details of at least 08 out of 10 of the following assignments. Oral examination will be based on below list of experiments.

1. To perform sieve analysis and classify the soil by any method using software/programming
2. Design of cantilever and gravity retaining wall for same problem statement.
3. To determine shear strength parameters using triaxial UU test, CU test and CD test.
4. Exercise on determination of pore pressure parameters using triaxial test.
5. Report on a field case study on soil stabilization using lime/cement.
6. Report on a Case study of soil stabilization using fly ash.
7. Explanation of any one ground improvement technique using a case study.
8. Site visit report for any type of retaining wall.
9. Ground Improvement technique – A review of stone column method with the case study.
10. Review of five research papers on clay minerals.

CAA:

Student should complete the assignment of each unit as a part of CAA.

P A Borkey

Course Name with Code: Air Pollution and Control (CE24304D)

Teaching Scheme:	Credits	Examination Scheme:
TH: 3 Hrs. / week	4	Activity : 10 Marks
PR: 2 Hrs. / week		In-semester : 30 Marks
		End semester : 60 Marks
		TW : 30 Marks

Prerequisite: Basic concepts of science and mathematics.

Course Objectives:

1. To provide general understanding of outdoor and indoor quality of air, its impacts and existing air acts.
2. To study meteorology, transport of air pollutants and its modelling aspects.
3. To discuss the various types of air pollution control equipment's and their design principles and limitation.

Course Outcomes:

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

1. Understand sources of air pollution and their local and global impacts.
2. Calculate concentration of pollutants as a function of meteorology.
3. Discuss sampling results with prescribed standards.
4. Understand indoor air pollution and its control techniques.
5. Recall air pollution control equipment.
6. Recall air acts and environmental impact assessment.

Course Contents

Unit I: History, Sources and Effects of Air Pollution **(07 Hours)**

Air Pollution- Definition, Sources, Types and classification, its effect on human health, vegetation, materials and properties, Air pollution Episodes and lesson learnt, Global effects: Global Warming, Acid Rain, Dust dome effects and Heat Island effect, Ozone Layer Depletion.

Unit II: Meteorology and Dispersion of Pollutants **(06 Hours)**

Meteorology and Atmospheric Stability. Lapse Rate, Plume Behaviour, and Air Quality Monitoring, Air Quality Index (AQI), Air Quality Modelling, Gaussian dispersion models for point source.

Unit III: Ambient Air Sampling and Analysis **(07 Hours)**

Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Emission inventory and source apportionment studies. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009.

Unit IV: Indoor Air Pollution **(06 Hours)**

Causes, sources and effects of indoor air pollutants, sick building syndrome. Sampling and assessment of indoor air quality, control of indoor air pollutants and air cleaning systems. Use of various plants to control indoor air pollution.

Ramudra
Mr. R. T. Pahl

Unit V: Control of Air Pollution **(06 Hours)**

Control of particulate and gaseous emissions: Settling chambers, Cyclone Separators, Wet collectors, Fabric Filters, Electrostatic Precipitators. Other removal methods like Absorption, Adsorption and Precipitation.

Unit VI: Air Acts, Introduction to Environmental Impact Assessment (EIA) **(07 Hours)**

Air pollution emission standards, National and international policies, acts, rules and regulations. Methodology for preparing environmental impact assessment (Identifying the sources of air pollution, calculating the incremental values, prediction of impacts and mitigation measures). Role of regulatory agencies and control boards in obtaining environmental clearance for project..

Books & Other Resources:

Reference Books

1. Air Pollution – H. V. N. Rao and M. N. Rao, TMH, Pub.
2. Air pollution – KVSG Murali krishna.
3. Environmental Engineering – Davis, McGraw Hill- Pub.
4. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.
5. Air Pollution Control – Martin Crawford.
6. Fundamentals of Air Pollution-Richard W. and Donald L. Academic Press.

Air Pollution and Control Lab

Term Work

Term work consists of a report on at least eight of the following topics:

1. Application of remote sensing and satellite-based data in air quality management.
2. International Environmental Treaties to Reduce Air Pollution and GHG Emissions.
3. Impact of Lockdown on air quality.
4. Visit to India Meteorological Department with reference to monitoring of meteorological parameters.
5. Mitigation Measures to Control Air Pollution in sectors such as Thermal Power plants/Industries/Domestic/Agriculture/Transportation.
6. Wind rose diagram construction and application using freeware.
7. Detailed industrial visit report on Cement/Steel/Thermal/Dairy industry with reference to air pollution Control devices.
8. Status of air quality in any city.
9. Stack emission monitoring.
10. Ozone layer depletion/ Global warming/ Climate change/ acid rain-A case study.

Activity: Assignments for each unit.

Rajendra
Dr. R. J. Patil

CE24304E – Advanced Concrete Technology		
Teaching Scheme:	**Credits: 04**	**Examination Scheme:**
TH: 03 Hrs./week	**Theory: 03**	**CAA: 10 Marks**
		In semester: 30 Marks
		End Semester: 60 Marks
PR: 02 Hrs./week	**Practical: 01**	**OR: 30 Marks**

Prerequisite:

1. Basic civil engineering, construction materials like lime, cement, natural & artificial sand and fundamentals of Concrete Technology.

Course Objectives:

1. To impart a deeper comprehension of cement chemistry, the impact of additional cementitious ingredients, and the impact of admixtures on concrete qualities.
2. To demonstrate the function of fibers and comprehend the durability characteristics of concrete.
3. To study sophisticated concrete testing techniques.

Course Outcomes: After completion of course students will be able to

CO1: Recognize the characteristics of concrete and the chemistry of cement.
CO2: Utilize the understanding of supplemental cementitious ingredients to create environmentally friendly concrete.
CO3: Explain the admixtures function and its effect on the characteristics of concrete.
CO4: Analyze the distinctive qualities of fiber-reinforced concrete.
CO5: Evaluate durability and quality characteristics of concrete.
CO6: Analyze characteristics of concrete using cutting-edge testing techniques.

Course Contents

Unit 1: Introduction of Cement and Concrete **07 Hours**

Various Cement types, Bogue's compounds, hydration of cement, hydrated cement paste structure, hydrated product volume, cement paste porosity, the interfacial transition zone (ITZ) in concrete, the impact of ITZ on concrete properties, types of concrete, types of elastic moduli, and factors influencing elastic modulus of concrete.

Unit 2: Industrial waste or by-products as cementitious Materials **06 Hours**

Industrial waste or by-products such as fly ash, blast furnace slag, silica fume, rice husk ash, metakaolin, chemical composition and classification, impact on portland cement hydration process, impact on concrete workability, impact on hardened concrete properties, and impact on concrete durability.

Unit 3: Role of admixtures of chemicals **07Hours** Admixture classification, chemistry and mechanism, impact of admixtures on plastic and hardened properties of concrete, uses, and specialty admixtures such as those that modify viscosity, preventive measures for corrosion, or reduce shrinkage.
Unit 4: Concrete reinforced with fiber **06Hours** Fiber types, interaction between fibres and matrix; steel fiber reinforced concrete (SFRC); steel fiber types; balling effect; impact on hardened concrete properties; applications; slurry infiltrated fiber concrete (SIFCON); fresh and hardened properties of SIFCON; applications; synthetic fiber reinforced concrete; types of synthetic fibers; characteristics of fibers; impact of fibers on concrete properties; applications.
Unit 5: Durability of concrete and quality control **07Hours** Introduction to plastic shrinkage, autogenous shrinkage, drying shrinkage; mitigation techniques, concrete transport characteristics, permeability, corrosion, carbonation, sulphate attack, acid attack, and chloride penetration. Guidelines for quality control of concrete.
Unit 6: Non-destructive testing of concrete **06Hours** Introduction to the theory of pulse propagation through concrete, ultrasonic pulse velocity method, results interpretation, corrosion: half-cell potential measurement, electrical resistivity method, permeability and absorption tests, concrete cores: location and size, drilling, testing and results interpretation, and in-situ load testing.
Books & Other Resources:
Textbooks 1. M. L. Gambhir, "Concrete Technology", Tata McGraw-Hill. 2. A.R. Santhakumar , "Concrete Technology", Oxford University Press. 3. Job Thomas, "Concrete Technology", Cengage Publications. **Reference Books** 1. A. M. Neville, "Properties of Concrete", Pearson Education. 2. P. Kumar Mehta and Paulo J.M. Monteiro, "Concrete: Microstructure, Properties, and Materials", McGraw Hill Education. 3. P.N. Balguru and P. N. Shah, "Fiber Reinforced Cement Composite", Tata McGraw-Hill. **IS Codes:**

1. IS 1199 – 1959, Methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi
2. IS 3085 – 1965, Method of test for permeability of cement mortar and concrete, Bureau of Indian Standards, New Delhi
3. 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
4. IS 516 – 1959, Method of tests for strength of concrete, Bureau of Indian Standards, New Delhi

For term work submission students have to complete following practical/assignments.

Term work: - Term work consists of performance of any five experiments from the list below. Oral examination based on term work.

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

Activity: Every unit should have a minimum of one thorough assignment that addresses every topic covered in that unit.

Course Name with Code: Waste Management (Course Code: CE24051)		
Teaching Scheme: **TH: 3 Hrs./week** **PR: 2 Hrs./week**	**4 Credits**	**Examination Scheme:** **Activity: 10 Marks** **In semester: 30 Marks** **End Semester: 60 Marks** **TW: 30 Marks**

Prerequisite:

1. Fundamentals of Environmental Studies, Engineering Chemistry

Course Objectives:

1. To understand problems of waste, estimate and characterize waste.
2. To apply the knowledge of mathematics, science, and engineering for effective waste collection systems and for waste collection route optimization.
3. To understand the working of waste to energy system.
4. To understand management and legal requirements of special waste, reuse, recycle and material recovery.

Course Outcomes: After Completion of course students will be able to

CO1: Apply the basics of waste management towards sustainable development.
CO2: explain methods of storage, collection and transportation of waste.
CO3: describe waste to energy systems from solid waste.
CO4: understand the process of conversion of waste to energy
CO5: understand legal requirements of special waste
CO6: understand the need of finance in waste management

Course Contents

Unit 1: Evolution, Sources and Types of Waste **07 Hours**

Introduction of waste, Functional elements, Types and sources of waste, Sampling and characteristics, Estimation of waste quantity, Factors affecting waste generation rate.

Unit 2: Collection and Transportation of Waste **07 Hours**

Integrated waste management, different methods of waste collection, transfer and transportation of waste, use of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicle location and optimization of route, methods of measuring waste.

Unit 3: Waste to energy **07 Hours**

Basic principles of processing and treatment of municipal solid waste, Materials recovery and recycling, composting, anaerobic digestion or bio methanation, incineration and sanitary landfilling.

Unit 4: Source Reduction, Product Recovery & Recycling **06 Hours**

Source Reduction, Product Recovery and Recycling: basics, purpose, implementation monitoring and evaluation of source reduction, significance of recycling, planning of a recycling programme, recycling programme elements, commonly recycled materials and processes, a case study.

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Unit 5: Special Waste Management and Regulations **06 Hours**

Objectives and key points of hazardous and other waste management rules- 2016, domestic hazardous waste, e-waste, biomedical waste, plastic waste, nuclear waste, slaughterhouse waste, construction & demolition waste, and lead battery waste.

Unit 6: Finance and Public-Private-Partnership (PPP) in Waste Management **06 Hours**

Introduction, purpose of Public-Private-Partnership (PPP), Financing in Waste management Projects, Public-Private-Partnership in Waste Management.

Books & Other Resources:

Textbooks

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

For term work submission students have to complete following practical/assignments.

Term work

1. Report on site visit to municipal solid waste management (Society/village/town/city).
2. Practical/theoretical identification of impacts of improper management of municipal solid waste.
3. Practical/theoretical sampling methods and characterization study of municipal solid waste.
4. Practical/theoretical estimation of solid waste generation and estimation of quantity
5. Prepare a report for management of any of the special wastes.
6. Prepare a report on use of smart technologies in solid waste management.
7. Determine calorific value of municipal solid waste using bomb calorimeter.

8. Determine moisture content and volatile solids for organic fraction of municipal solid waste.

Activity:

Assignments on each unit.

CE24052 – Green Building and Smart Cities		
Scheme:	**Credits: 4**	**Examination Scheme:**
TH: Teaching 3 Hrs./week	**Theory: 3**	**CAA: 10 Marks**
		In semester: 30 Marks
		End Semester: 60 Marks
PR: 2 Hrs./week	**Practical: 1**	**TW: 30 Marks**

Prerequisite:

1. Global Warming, Building Materials.

Course Objectives:

1. To understand the definition, concept & objectives of the green building and to imbibe basics of green design.
2. To understand planning specifications of green building.
3. To understand the definition, concept & objectives of the smart city.
4. To understand the policies of smart city.

Course Outcomes: After Completion of course students will be able to

CO1: Demonstrate green concept skills and apply tools of green building assessment.

CO2: Select appropriate green building material and technique.

CO3: Acquaint knowledge on energy conservation building code.

CO4: Acquaint knowledge on smart cities planning and development.

CO5: Select alternative resources of energy.

CO6: Develop work break down structure, scheduling and project management of smart cities.

Course Contents

Unit 1: Concept of Green Buildings **07 Hours**

a) Definition of Green Buildings, typical features of green buildings, Necessity, Initiatives, Green buildings in India, Green building Assessment- Green Building Rating Systems (BREEAM, USGBC, LEED, IGBC, TERI-GRIHA, GREEN STAR), Criteria for rating, Energy efficient criteria, environmental benefits economic benefits, health and social benefits, Major energy efficiency areas for building, Life cycle cost of buildings, Codes and Certification Program

b) **Green Design**: Definition, Principles of sustainable development in Building Design, Characteristics of Sustainable Buildings, sustainably managed Materials, Integrated Lifecycle design of Materials and Structures (Concepts only)

Unit 2: Green Building Materials, Planning and Specifications **07 Hours**

a) **Green Building Materials**: Sustainably managed Materials, depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; Embodied Energy of Materials, Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds (VOC's), Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials.

b) **Green Building Planning and Specifications**: Environment friendly and cost-effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Alternative Construction Methods, Energy Conservation Measures in Buildings, Waste & Water management and Recycling in Sustainable Facilities, Heating, Ventilation and Air Conditioning, Passive Solar & Daylight, Plumbing and its Effect on Energy Consumption

Unit 3: Building Integrated Photo Voltaic **06 Hours**

Introduction to use of Building Integrated Photo Voltaic (BIPV) and other renewable energy in building their basic concepts and efficiency, introduction to energy conservation code (ECBC-2017), introduction to concepts of overall thermal transfer value (OTTV).

Unit 4: Introduction to Smart cities **07 Hours**

a) Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city world and India. Need to develop smart city. Introduction to city planning, Concept, principle stakeholders, key trends in smart cities developments.

b) **Intelligent transport systems**: Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing

Unit 5: Singular- Hybrid Smart Cities **06 Hours**

Conventional Cities, dimensions of smart cities, phases stages of project and their approval status, smart city components, energy demand, green approach to meet energy demand, introduction to static analysis.

Unit 6: Policies in Smart Cities **06 Hours**

Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city. Worldwide policies for smart city Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.

Books & Other Resources:

Textbooks

1. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama

Reddy & K S Nanjunda Rao – New Age International Publishers .
2. Integrated Life Cycle Design of Structures – By AskoSarja – SPON Press.
3. Green Buildings (McGraw hill publication): by Gevorkian.
4. Smart City on Future Life - Scientific Planning and Construction by Xianyi Li.
5. The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities) by Nicos Komninos.
6. Mission statement &guidelines on Smart City Scheme". Government of India - Ministry of Urban Development.

List of free reference guides/resources available on the net:

1. http://smartcities.gov.in/upload/uploadfiles/files/Smart City Guidelines.
2. IGBC reference guide.
3. Free abridged versions of LEED reference guides.

For term work submission students have to complete following practical/assignments.

Term work

1. Assignment on- Identify sources of pollution in your area.
2. Assignment on- Technology involved in different construction of green building.
3. Assignment on- Technology involved in different construction of smart building
4. Assignment on- Permanent installation of energy meter.
5. Assignment on- Reducing the consumption of water used outdoors
6. Assignment on- Collecting and sorting of waste during the operation of the building
7. Site visit to green building/ smart city.
8. Case study of Structural Audit on green building.

Activity:

Assignment on each unit.

Dr. S. B. Walke

CE24305PR- Civil Engineering Software Lab II

Teaching Scheme:	Credits	Examination Scheme:
PR: 2 Hrs. / week Tutorial: 1 Hrs. / week	2	CAA: 10 Marks TW : 30 Marks PR : 30 Marks

Prerequisite:

Students should have a solid understanding of the following subjects.

1. Mathematics: Vector analysis.
2. Matrix, differential equations.
3. Strength of Materials.
4. Structural Analysis.
5. Steel Design.
6. Concrete Design.
7. Foundation Design

Course Objectives:

1. To learn basic operations in ETABS/STAAD Pro

Course Outcomes: students will be able to

Carry out an analysis of the RCC structure.

List of Practicals

1. Introduction to ETABS/STAAD Pro Basics
   a) General Tools,
   b) Commands & their Functions in ETABS/STAAD Pro.
2. Modelling in ETABS/STAAD Pro
   a) Modelling
      - Model Initialization Methods
      - Defining Grids Part-1 (Uniform Grid Spacing)
      - Defining Grids Part-2 (Custom Grid Spacing)
      - Modelling of a Simple Beam
      - Defining Material Properties
      - Defining Sectional Properties
      - Creating Frame over Grid Lines
      - Assigning Restraints / Support
   b) Load Patterns, Load Cases & Their Combinations
      - Defining load pattern, load case, and combinations

- Assigning load over the frames

c) Analysis & Design of Model
- Check the Model for Error
- Analyzing The Model
- Generate SFD and BMD
- Design of Model

3. ANALYSIS & DESIGN OF G+1 BUILDING
   a) Study of Building Drawing
   b) Importing CAD File In ETABS/ STAAD Pro
   c) Assigning & Modifying Grid Lines
   d) Defining Material & Sectional Properties
   e) Modelling of Building
   f) Assigning Sectional Properties
   g) Defining Load Patterns & Combination
   h) Assigning Loads on Building Frames
   i) Analyzing the Model & Generating SFD and BMD
   j) Design of Structure
   k) Schedule of Reinforcement

Practical examination is based on the above syllabus content

07/07/2026

HS24301 Constitution of India			
Teaching Scheme	**Credit: Non Credit Audit Course**	**Examination Scheme**	
TH 01 Hrs/Week		Course Activity:	NIL
		End Semester:	NIL
	TH Credit :NIL	Total	NIL

Course Objective:

The primary objectives of this course are to:

- Familiarize students with the salient features, structure, and significance of the Constitution, including the principles enshrined in the Preamble.
- Provide an understanding of fundamental rights and duties, their scope, significance, and role in ensuring justice, equality, and freedom in a democratic society
- Explain the concept of Directive Principles of State Policy (DPSP) and their role in governance, emphasizing their interrelationship with Fundamental Rights.
- Analyze emergency provisions and constitutional amendments, discussing their implications on Indian democracy and governance.
- Encourage a comparative understanding of the Indian Constitution with other constitutions worldwide, fostering awareness of global governance models.

Course Outcomes:

At the end of the course, students will be able

CO1: Describe the salient features and basic structure doctrine of the Constitution and Interpret the values enshrined in the Preamble

CO2: Comprehend Fundamental Rights and Duties of Indian Citizens

CO3: Analyze the Role of Directive Principles of State Policy (DPSP) in Governance

Course Contents		
Mapping of Course Outcomes for Unit I	CO1	
UNIT I	**Introduction to the Constitution of India**	**05 Hours**
Historical Perspective and Making of the Indian Constitution, Salient Features of the Constitution, Preamble and its Significance, Basic Structure of the Constitution		
Mapping of Course Outcomes for Unit II	CO2	
UNIT II	**Fundamental Rights and Duties**	**04 Hours**
Fundamental Rights: Meaning, Scope, and Significance, Right to Equality, Freedom, Protection from Exploitation, Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Fundamental Duties of Indian Citizens		
Mapping of Course Outcomes for Unit III	CO3	
UNIT III	**Directive Principles and Governance**	**04 Hours**
Directive Principles of State Policy: Meaning and Purpose, Relationship between Fundamental Rights and Directive Principles, Role of Directive Principles in Policy Formulation, Comparison with Other Constitutions		

Books and Other Resources
Text and Reference Books: 6. M. Laxmikanth, Indian Polity, McGraw Hill Education, 6th Edition, 2020. 7. D.D. Basu, Introduction to the Constitution of India, LexisNexis, 25th Edition, 2021. 8. Subhash Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust, 2019. 9. J.N. Pandey, The Constitutional Law of India, Central Law Agency, 2020. 10. Bare Act, Constitution of India, Government of India Publications.
Evaluation and Assessment Since this is an audit course, there is a mandatory internal evaluation which can be based on the following: • Assignments & Reports– Writing about a constitutional provision or case study. • Quiz/MCQs – To test basic understanding of the Constitution. • Group Discussion/Presentation – On relevant topics like Fundamental Rights or Constitutional Amendments

Course Name with Code: Structure Design for Reinforced Concrete (CE24311TH)

Teaching Scheme:	Credits	Examination Scheme:
TH : 03Hrs/week	04	Activity: 10 Marks
PR : 02Hrs/Week		In Semester: 30 Marks
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

1. Fundamentals of Engineering Mechanics, Concrete Technology, Mechanics of Materials and Structural Analysis

Course Objectives:

1. To analyze, design and detailing of different component of reinforced concrete framed structure building.

Course Outcomes:

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

CO1: Apply relevant IS provisions for LSM to ensure safety and serviceability of structural members and evaluate moment of resistance for singly, doubly rectangular, and flanged sections.
CO2: Design & detailing of one way and two-way slab with different support conditions.
CO3: Design & detailing of dog legged, open well staircase and beams.
CO4: Design & detailing of continuous beams for flexure, shear and bond.
CO5: Design & detailing of short columns subjected to axial load, uni-axial/bi-axial bending.
CO6: Design & detailing of isolated column footing for axial load and uni-axial bending.

Course Contents

Unit I: Overview of design theories and RC beam section analysis. **(07 Hours)**

Introduction to design philosophies of RC structures: working stress method and limit state method, types of Limit states, loads on RC structural members and structural properties of concrete and steel, Role of structural engineer, RC sections in flexure, theory and analysis, singly, doubly reinforced rectangular and flanged sections.

Unit II: Design of slabs **(06Hours)**

Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code Coefficients, design of two way slab: continuous and restrained as per Indian Standard code, reinforcement detailing for slabs.

Unit III: Design of staircase and beams **(07 Hours)**

Introduction to type of staircase and beams, Design of staircase: dog legged and open well, distribution of load from to beams, design of simply supported and cantilever beams for flexure (singly reinforced, doubly reinforced and flanged) with checks for shear, bond and torsion.

Unit IV: Design of continuous beams **(06 Hours)**

Introduction to redistribution of moment and requirement, design of continuous beam by using IS code coefficients and moment redistribution method with checks for shear, deflection and development length. Reinforcement detailing for continuous beams.

Unit V: Design of short RC columns **(07 Hours)**

Introduction to types of columns, check for 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 using Indian Standard code and SP-16. Reinforcement detailing for columns.

Unit VI: Design of isolated RC columns footings **(06 Hours)**

Introduction to type of column footings in RC framed structure, soil pressure distribution under isolated footing, check for shear and bearing, design and reinforcement detailing of isolated column footing for axial load and uni-axial bending using Indian Standard code.

Books & Other Resources:

Text books:

1. Dr. V. L. Shah and Dr. S. R. Karve, "Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune.
2. N. Subramanian, "Design of Reinforced Concrete Structures", Oxford University Press.
3. S. U. Pillai and D. Menon, "Reinforced Concrete Design", Tata McGraw Hill, Delhi.

Reference books:

1. P. Dayaratnram, "Limit State Analysis and Design", Wheeler Publishing Company.
2. Dr. V. L. Shah and Dr. S. R. Karve, "Illustrated Design of Reinforced Concrete Buildings (G+3)", Structures Publications, Pune.
3. P. C. Varghese, "Limit State Design of Reinforced Concrete", PHI, New Delhi.
4. Sinha and Roy, "RCC Analysis and Design", S. Chand and Co. New Delhi.

Reference codes and standards:-

1. IS: 456-2000: Plain and Reinforced Concrete – Code of Practice, BIS, New Delhi.
2. SP 34 – Handbook on Concrete Reinforcement and detailing
3. SP 16 – Design Aids for Reinforced concrete to IS 456:1980 Code Book.

Course Name with Code: Structure Design for Reinforced Concrete (CE24311PR)
Laboratory Experiments/Assignments

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

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

1. 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 all slabs.
   - iii. Design of plinth, floor and roof beams.
   - 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. Prepare schedule of RC elements and reinforcement detailing on four full imperial drawing sheets.
2. Analysis or design any one RC element by using spread sheet.
3. Reports of two site visits on RC framed buildings under construction.

Activity- One assignment on each unit

CE24312-Hydrology & Irrigation Engineering

Teaching Scheme:	Credits	Examination Scheme:
TH:2 Hrs/week	03	CAA :10 Marks
PR:2 Hrs/Week		End Semester :60Marks
		OR : 30 Marks

Prerequisite:

Fundamentals of fluid mechanics, metrological data.

Companion Course, if any: Laboratory Practical

Course Objectives: Students should have the ability to:

1. Introduce different government organizations and make them aware about precipitation, runoff, runoff hydrographs.
2. Introduce the concept of run off, floods and hydrologic routing methods.
3. Impart knowledge of irrigation methods.
4. Impart knowledge of irrigation, crop water requirement, canal distribution network, piped distribution network and water management.

Course Outcomes: Students will be able to

1. Understand government organizations, apply & analyze precipitation & its abstractions.
2. Understand, apply & analyze runoff, runoff hydrographs.
3. Understand irrigation and its type.
4. Understand crop water requirements and calculate canal/reservoir discharge.

Course Contents

Unit I: Hydrological Cycle **(07 Hours)**

Hydrological cycle, applications of hydrology, Precipitation: Types & forms of precipitation, precipitation measurement, rain gauge network, Presentation of rainfall data, mass rainfall curves, hyetograph, point rainfall, mean precipitation over an area, arithmetic mean method, Thiessen's polygon, isohyetel method, evaporation, transpiration, evapotranspiration, infiltration: introduction, infiltration capacity, infiltration indices.

Unit II: Runoff **(07Hours)**

Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff, Runoff hydrograph: Introduction, flood, flood routing methods, 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).

Unit III: Introduction to Irrigation Engineering **(07 Hours)**

Definition, functions, advantages and necessity, methods of irrigation, surface irrigation, Furrow method, contour farming, sprinkler method, subsurface irrigation, natural subsurface, artificial subsurface, micro-irrigation, components, advantages and disadvantages of micro irrigation methods.

Unit IV: Water requirements of crops **(07 Hours)**

Water requirements of crops: Soil moisture and crop - water relationships, consumptive use of water, principal Indian crops, crop seasons, crop water requirement: Crop planning, agricultural practices, technical terms used in water application, calculations of canal discharge and reservoir capacities – duty, delta, Methods of improving duty, irrigation efficiency, Piped distribution

network for irrigation (PDN), Introduction, advantages and disadvantages of PDN over conventional canal distribution network and its application, water management.

Books & Other Resources:

Text books:

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

Reference books:

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

Laboratory Experiments/Assignments (Perform any 8)

1. Analysis of rainfall data.
2. Marking catchment area on a topo-sheet and working out average annual precipitation.
3. Determination of storage capacity of a reservoir using mass curve of inflow and outflow.
4. Measurement of evaporation by pan evaporimeter - case study analysis.
5 Measurement of / video demonstration of infiltration by infiltrometer.
6. Visit to weather station and report writing.
7. Irrigation methods/ systems – case study or research paper analysis.
8. Introduction to Cropwat software (demonstration & report writing)
9. Application of open-source GIS software for delineation of catchment/watershed.

CE24313A-Construction Management and Finance

Teaching Scheme:	Credits	Examination Scheme:
TH: 3 Hrs/week	04	CAA: 10 Marks
PR: 2 Hrs/Week		In Semester: 30 Marks
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

Fundamentals of Project management, Indian Construction Industry, Economics & finance

Course Objectives:

Students will be able to:

1. Understand various construction activities and evaluating construction projects.
2. Explain methods of planning and scheduling.
3. Describe methods of material and manpower management and its application.
4. Discuss various labour laws and financial aspects.
5. Differentiate budgets and use methods of capital budgeting in project selection.
6. Explain contract costing and its importance in finance.

Course Outcomes:

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

CO1: Understand the overview of construction sector.

CO2: Explain and apply the methods of planning and scheduling.

CO3: Describe and apply methods of material and manpower planning.

CO4: Discuss various labour laws and financial aspects.

CO5: Select best project which is profitable to the business.

CO6: Prepare contract account and analyses its implications of finance.

Course Contents

Unit I: Overview of Construction industry **(07 Hours)**

Organisational structure of construction industry, 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 project planning & Scheduling **(07 Hours)**

Construction project scheduling: definition, objectives factors affecting scheduling, work breakdown structure, project work break down levels, project monitoring controlling, Bar chart ,Networking methods,CPM,PERT(advantages disadvantages and application), software's used in planning & scheduling.

Unit III: Material and Manpower management **(07 Hours)**

Concept of material management, role of material manager, inventory control methods, EOQ Model, stores management and control, break even analysis, supply chain management, role of ERP in material management.

Human resource: introduction, human resource in construction sector, human resource management process, human resource development process, recruitment & selection, performance evaluation and appraisal, training & development, manpower planning- Resource smoothing and leveling.

Unit IV: 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 1986, 2016, interstate migrant workers act 1979, 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 V: 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 VI: Construction financial management **(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.

Books & Other Resources:

Text books:

1. Projects: Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata Mc Graw Hill Publications.
2. Total Project Management - The Indian Context, P. K. Joy, Mac Millian Publications.
3. Industrial Organization & Engineering Economics, T. R. Banga and S. C. Sharma, Khanna Publisher.
4. Indian Economy, Gaurav Datt and Ashwani Mahajan, S. Chand Publication.
5. Engineering Economics Management, Dr. Vilas Kulkarni and Hardik Bavishi, S. Chand Publication.

Reference books:

1. Construction Project Management-Planning, Scheduling and Controlling, K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
2. Construction Management and Planning, B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
3. Principles of Construction Management, Roy Pilcher (Mc Graw Hill).
4. Financial Management, Khan and Jain, Tata McGraw-Hill Education.
5. Construction Management and Accounts, Singh H, Tata McGraw Hill, New Delhi.
6. Finance for Engineers: Evaluation and Funding of Capital Projects, Crundwell F. K., Springer, London.
7. Labour and Industrial Laws, S. N. Mishra, Central Law Publications.

Construction Management and Finance Lab.-

Laboratory Experiments/Assignments (Perform Any 8)

Oral is based on the above syllabus and lab/term work completed.

1. Prepare an organizational structure/ chart of any one private organization executing construction work in your area.
2. Prepare a work break down structure of any construction site in your area, write a roles and responsibilities of personnel involved and time schedule of activities.
3. Prepare a bar chart of any small construction project.
4. Prepare a network diagram from the data of time schedule and work break for small project.
5. Exercise on CPM and PERT.
6. Visit to any construction store, collect data and conduct ABC analysis.
7. Carry out resource smoothing/ leveling of the given project data.
8. Prepare a profit and loss account of a given project data.
9. Conduct analysis of balance sheet of any construction industry.
10. Exercise on methods of capital budgeting and on depreciation.
11. Assignment on different labour laws associated with construction industries.
12. Prepare a contract account of completed and in progress contract.

CAA:

Students have to submit assignments for each unit as a part of continuous assessment activities (CAA)

Course Name with Code: Formwork and Plumbing Engineering (CE24313B)

Teaching Scheme:	Credits	Examination Scheme:
TH : 03 Hrs/week	04	Activity:10 Marks
PR : 02 Hrs/Week		In Semester: 30 Marks
		End Semester:60 Marks
		OR: 30 Marks

Prerequisite:

Structural Analysis, Concrete Technology, Building Technology.

Course Objectives:

1. Exposure to formwork techniques in the construction industry.
2. Examine the various forms of formwork, including their design and analysis.
3. Exposure to plumbing types and components.
4. Examine various plumbing system design provisions.

Course Outcomes:

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

CO1: Identify the right formwork type and material.

CO2: Examine and analyze the formwork under different loading conditions.

CO3: Demonstrate and design formwork elements under different conditions.

CO4: Recognize a building's plumbing requirements.

CO5: Understand the principles of plumbing hydraulics and the parts that make up a plumbing system.

CO6: Illustrate the design aspects and design of plumbing system using Indian Standards.

Course Contents

Unit I: Introduction to formwork. **(06 Hours)**

Overview of formwork as a provisional construction and its specifications, selection criteria of formwork, Forms of formwork; traditional formwork materials, such as steel, plywood, and timber; Advanced formwork materials, such as fiber reinforced polymer composites, plastic, and aluminum; Formwork planning, formwork economy, and accessories.

Unit II: Analysis of Formwork **(07 Hours)**

Typical illustration forms for walls, beams, columns, and slab with detailing, loads on formwork: dead loads, live loads, lateral pressure owing to fresh concrete according to IS 14687. Concrete density, discharge height, temperature, placement rate, concrete consistency, vibration, hydrostatic pressure and pressure distribution, examples, design considerations, allowable stresses, deflection limits, and common design flaws.

Unit III: Design of Formwork **(07 Hours)**

Formwork design concepts for slabs, beams, columns, and footings; slab and wall formwork design; and a demonstration of a beam and column formwork system.

Unit IV: An Overview of Building Plumbing **(06 Hours)**

Plumbing history, plumbing codes, plumbing organizations and institutes in India and abroad, the necessity of sustainable plumbing practices, the function of plumbing designers, the function of plumbers, plumbing system installations, and upcoming plumbing challenges, Water-borne illness, the significance of premise plumbing.

Unit V: Plumbing hydraulics and plumbing system components **(06 Hours)**

Water demand in various building types according to standards, components of water supply systems in buildings, types of water supply systems in buildings, types of drainage systems in buildings, frictional losses in pipes, minor losses in pipes, common plumbing fixtures, water-efficient fixtures, pipe materials and roughness coefficients, types of fittings, types of valves, types of traps, equivalent lengths for fittings and valves as per standards.

Unit VI: Design of plumbing systems **(07 Hours)**

Code requirements for plumbing systems include pressure and velocity, simultaneous demand, various pipe sizing techniques in buildings (such as fixture units, water demand calculators, fixture value methods, etc.), the use of segmented loss method for sizing pipes in three-story buildings, the arrangement of plumbing fixtures in toilets, plumbing plans for buildings, and water supply and drainage fixture units for various plumbing fixtures.

Books & Other Resources:

Text books:

1. Modern Practices in Formwork for Civil Engineering Construction Works, Dr. Janardan Jha & Prof. S. K. Sinha, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.
2. Formwork for Concrete Structures, Robert L. Peurifoy and Garold D. Oberlender, McGrawhill Publication.
3. Plumbing: Design and Practice, Deolalikar S. G., Tata Mcgraw-Hill Publication.
4. Water Supply and Sanitary Installation (Within Building), Design, Construction and
5. Maintenance Panchdhari A. C., New Age International publishers.

Reference books:

1. Formwork by Michael P. Hurst, Addison-Wesley Longman Ltd; First Edition (June 1, 1983).
2. Formwork for Concrete, Hurd, M.K., Special Publication No.4, American Concrete Institute, Detroit; Fifth edition
3. Design and Construction of Formwork for Concrete Structures by A.E. Wynn, George Philip Manning, Cement & Concrete Association.
4. Austin C.K., Formwork for Concrete, Cleaver-Hume Press Ltd., London, 1996.

Indian Standards:

1. IS 6461: Part V: 1972, Reaffirmed 2002; Glossary of terms relating to cement concrete: Formwork for concrete, Bureau of Indian Standard, New Delhi.
2. IS 14687: 1999, Falsework for Concrete Structures – guidelines, Bureau of Indian Standard, New Delhi.
3. IS 12183-1-1987, Code of practice for plumbing in multi-storeyed buildings (Part 1 water supply), Bureau of Indian Standards, New Delhi, India.
4. Uniform Illustrated Plumbing Code - India 2018, International Association of Plumbing and Mechanical Officials India.
5. International Plumbing Code - 2018, Appendix E, International Code Council, USA.
6. National Building Code of India - 2016, Vol. 2, Part 9, Bureau of Indian Standards, New Delhi, India.

Laboratory Experiments/Assignments

The term work shall consist of a journal giving details at least 08 out of 10 of the following experiments. Oral Examination would be based on the term work.

1. Design of timber/steel formwork for slab. (Group of maximum Five students)
2. Design of timber/steel formwork for wall. (Group of maximum Five students)
3. Model making of any formwork. (Group of maximum Five students)
4. Analysis and design of any formwork using suitable software.
5. Model making of plumbing for G + 2 building. (Group of maximum Five students)
6. Design of plumbing systems. (Group of maximum Five students)
7. Detailing of plumbing system installation as per Indian Standard.
8. Detailing of plumbing hydraulics and plumbing components.
9. Site visit to view standard formwork and formwork for unique structures or formwork.
10. Site visit to industrial plumbing system

Activity: Assignments for each unit.

Course Name with Code: Airport and Bridge Engineering (CE 24313C)

Teaching Scheme:	**Credits**	**Examination Scheme:**
TH : 0 3 Hrs/week	**04**	**Activity: 10 Marks**
PR : 0 2 Hrs/Week		**In Semester: 30 Marks**
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

Basic of computer and Infrastructure Engineering, understanding of drawings and specifications.

Course Objectives:

1. Introduce the aspect of airport and bridge system.
2. Study plans, specifications for planning and design.
3. Involve in the planning of new runways and terminal buildings
4. Select the bridge that will meet the needs of the area

Course Outcomes:

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

CO1: Understand airport planning, components, and classification.

CO2: Describe aircraft characteristics and airport geometric design

CO3: Explain airport visualization, capacity analysis, and airport pavement systems.

CO4: Describe airport marking, lighting systems, and heliport planning

CO5: Understand bridge planning, hydraulic design aspects, IRC loads, and basic bridge components.

CO6: Identify types of culverts and bridges, basic construction methods, bridge materials, and the purpose and types of bridge bearings.

Course Contents

Unit I: Introduction and Classification of Airport **(07 Hours)**

Introduction to air transportation systems and the development of civil aviation. Principles of airport planning and layout including runways, taxiways, aprons, terminal buildings, hangars, and support facilities. Concepts of airport site selection, airport land-use planning, obstruction limitations, and zoning regulations related to permissible heights of constructions near airports. Introduction to air navigation and landing aids such as Instrument Landing System (ILS) and the role of Air Traffic Control (ATC) in ensuring safe and efficient aircraft operations.

Airport classification: community size and airport types, airport classification according to types of services, functional classification of airports, airport classification for the purpose of stipulating geometric standards, ICAO, FAA, Green Airport Concept, Digital Twin for airport operations and lifecycle management. Passive Defense Measures for Airports, Anti-Drone (C-UAS) Infrastructure. Expedient Airfields.

Unit II: Aircraft Characterizes and Geometric design **(07 Hours)**

Introduction to Aircraft Characterizes: related to airport design characterizes of principle transport aircrafts, trends size, speed, and productivity of transport aircraft, turning radii. airport planning, size and type of airport, selection of site for the airport.

Geometric design: element of an airport, runway and taxi way width, runway profile and runway length, runway orientation, corrections and calculation, introduction to analytical methods for air travel demand for planning and casting, case study- airport master plan.

Unit III: Airport Visualizing, Airport Capacity and Airport Pavements **(07 Hours)**

Airports visualizing: introduction to visualizing airports in a virtual environment, building information modelling (BIM) for air ports, introduction to augmented reality (AR) and virtual reality (VR) in airport planning and design,

Airport capacity: ultimate and practical runway capacity, runway arrangement factors effecting runway capacity, practical annual capacity, and practical hourly capacity,

Airport pavements: comparison- highway and airfield pavement, Rigid airport pavements and flexible pavement, Rapid Runway Repair (RRR), airport drainage. Urban flooding hazard for Airports, Sustainable Urban Drainage Systems (SuDS) within the airport context

Unit IV: Airport Marking and Lighting- Heliports **(06 Hours)**

Airport Marking and lighting: the need for marking and lighting, runway lighting, runway marking, runway designation marking, runway centre marking, threshold marking, fixed distance marking , touchdown zone marking , runway side strips marking, Solar Runway Lighting

Heliports: helicopter characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, heliport marking and lighting, vertical take-off, and landing (VTOL), short take-off and landing (STOL). **Vertiport Design for Urban Air Mobility (UAM).** Drones and Electric Vertical Take-off and Landing (eVTOL) aircrafts.

Unit V: Introduction to Bridges **(06 Hours)**

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

Unit VI: Types of Bridges **(06 Hours)**

Culvert: definition, location, waterway of culvert and types, pipe culverts, box culvert. Washing away issue of Culverts in High rainfall hilly area catchment. **Temporary bridges**: definition, materials used, brief general ideas about timber, floating- pontoon bridges. (Introduction only), **Movable bridges:** bascule, cut boat, flying, swing, lift, transporter and transverse bridges, their requirement and suitability. (Introduction only), **Fixed span bridges**: simple, continuous, cantilever, arch, suspension, bowstring girder type and rigid frame and cable stayed bridges, Segmental Construction, and Incremental Launching. Materials for super structure. Assault & Support Bridging

Bearing: definition, purpose and importance, types of bearings with their suitability (Introduction only).

Books & Other Resources:

Text books:

1. Airport Engineering, by Saxena S.C., CBS Publishers & Distributors
2. Airport planning and design – S.K. Khanna, M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee
3. Bridge Engineering by Rangwala, Charotar Publication
4. Airport Engineering by Rangwala, Charotar Publication

Reference books:

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

Handbooks and Manuals:

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

Laboratory Experiments/Assignments

Term work consists of the following. Oral Examination would be based on the term work

A. **Compulsory assignment**

1. Runway design for length and related corrections, and sketches of essential runway markings.
2. Site visit to bridge site or airport site (report on visit)
3. Select best Airports, bridges in the world, and prepare its PPT and its presentation in practical along with submission of report on its details.
4. Seminar presentation on one of the given topics from Syllabus and submission of report

B. **Any Five from the following**

1. Report on study of recent trends in airport planning and design.
2. Airport safety and Aircraft accident investigation (case studies)
3. Building information modeling (BIM) system.
4. Report on guest lecture in applications of AR and VR in Airport or bridge engineering.
5. Prepare the drawing/plate (A3)/PPTs on airport marking and lighting (describing importance)
6. Study of planning and importance of Heliports.
7. Study of military and emergency use of Airports during war situations
8. Selection of bridge site, alignment, and collection of design data.
9. Study of movable bridges/ temporary bridges/bearing.
10. Study of bridge substructure
11. Design of pipe culverts and design of box culvert (Single vent only) one each.

Activity: Assignments for each unit.

Course Name with Code: Structural design of bridges (CE24313D)

Teaching Scheme:	Credits	Examination Scheme:
TH : 3 Hrs/week	04	Activity: 10 Marks
PR : 2 Hrs/Week		In Semester: 30 Marks
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

1. Fundamentals of Structural Analysis, Design of Steel Structure, Design of reinforced concrete Structure, Design of prestressed concrete elements.

Course Objectives:

1. To recognize the appropriate types of bridge structures as per site conditions.
2. To analyze and design reinforced concrete, steel and prestressed concrete bridges.

Course Outcomes:

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

CO1: Identify loads on bridges and selection of type of bridge for the site condition as per Indian Standards.
CO2: Design the reinforced concrete deck slab, culvert slab and T beam deck slab for highway bridges.
CO3: Analysis and design of reinforced concrete and post tension prestressed concrete girders.
CO4: Classify the types of rail bridges and design the Truss steel bridges
CO5: Recognize different types of bearing and design the bearings for bridges.
CO6: Analysis and design of RC abutments and piers for bridges

Course Contents

Unit I: Introduction to highway and railway bridges **(07 Hours)**

Types of RC highway and steel railway bridges, IRC loading standard for RC highway bridges, IRS codal provisions for railway steel bridges, impact factors for moving loads as per IRC loading standards and equivalent uniformly distributed load (EUDL).

Unit II: RC highway bridges **(06Hours)**

Slab culvert and T-beam deck slab bridges – Design of slab culvert, Deck slab: Structural configuration, Piegaud's method, analysis and design of deck slab supported on all sides for T-beam.

Unit III: RC highway bridges using post tensioned prestressed concrete girders **(07 Hours)**

T-beam deck slab bridges – Post tensioned girders: Load distribution on longitudinal and cross girders, Courbon's theory, analysis and design of longitudinal and cross girders.

Unit IV: Railway steel bridges **(06 Hours)**

Introduction to types of railway steel bridges, Truss bridges: Structural configurations, loads and load combinations, analysis and design of truss elements, longitudinal and cross-girders, bracing systems.

Unit V: Bridge bearings **(07 Hours)**

Introduction to types of bearings, general features and function of various types bearings, design of steel bearings and elastomeric bearings.

Unit VI: Bridge Sub-structure **(06 Hours)**

Introduction of sub-structure, function of bridge sub-structure, loads on sub-structure, analysis and design of RC abutments and piers.

Books & Other Resources:

Text books:

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

Reference books:

1. Johnson Vector D, "Essentials of Bridge Engineering", Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
2. Ramachandra, "Design of Steel Structures", Standard Publications New-Delhi.
3. Rajagopalan. N., "Bridge Superstructure", Alpha Science International, New Delhi.
4. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi.

Laboratory Experiments/Assignments

The term work shall consist of a journal giving details of at least 01 out of 02 projects of the following experiments. Practical/Oral Examination would be based on the term work.
Note: - The term work can be prepared in a group of not more than four students in a group.

1. Project on RC highway bridges which shall include - the design of deck slab, longitudinal girder, cross-girder, bearings and abutment and pier. The detailing shall be shown in at least three full imperial sheets.
2. Project on railway steel bridges which shall include – the design of truss elements, longitudinal girder, cross-girder, and bearings. The detailing shall be shown in at least two full imperial sheets.
3. Report of at least two site visits covering the contents of the syllabus.

Activity:- One assignment on each unit

Course Name with Code: Advanced Engineering Geology with Rock Mechanics (CE24313E)

Advanced Engineering Geology with Rock Mechanics (CE24313ETH)

Teaching Scheme:	**4 Credits**	**Examination Scheme:**
TH: 3 Hrs./week		**Activity: 10 Marks**
PR: 2 Hrs./week		**In semester: 30 Marks**
		End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

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

Course Objectives:

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

Course Outcomes: After Completion of course students will be able to

CO1: Illustrate seismic zones, plate tectonics and civil engineering significance of major rock formations of India with their characteristics.

CO2: Explain soil profile, geo-hydrological characters of various rock formations and necessity of geological studies in water conservation.

CO3: Apply knowledge of geology in Infrastructural, Urban development and demonstrate importance of national wealth.

CO4: Validate the suitability of rocks based on mechanical properties, R.Q.D. and geophysical exploration.

CO5: Explore subsurface Geology for civil engineering projects to suggest foundation treatments for various geological defects and channel erosion.

CO6: Illustrate the suitability of proposed alignments for tunnels and bridges on the basis of Geological investigations.

Course Contents

Unit I: Seismic Zones of India

(7 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

(6 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

(7 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

(6 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 geomechanical 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

(7 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

(6 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.

Books & Other Resources:

Textbooks:

1. Engineering Geology, Subinoy Gangopadhyay, Oxford University Press.

2. Introduction to Rock Mechanics, B. P. Verma, Khanna Pub New Delhi

Reference books:

1. Fundamentals of Rock Mechanics, Jaeger J. C., Cook N. and Zimmerman R, Blackwell Scientific Publications.

2. Introduction to Rock Mechanics, Goodman R. E., John Wiley & Sons.

3. Introduction to Geophysical Prospecting, M. B. Dobbrin, McGraw Hill Inc.

4. Environmental Geology, Keller E A, Prentice Hall Publication.

5. 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:

1. P. W. D. Handbook Chapter - 6, Part-II Engineering Geology, Gupte R. B. Government of Maharashtra.

2. Manual on Rock Mechanics, Central Board of Irrigation and Power, New Delhi.

3. Handbook of Geological terms, geology and Physical Geology, David page, University of Michigan.

4. Handbook of Geology in Civil Engineering, Robert Fergussion , Legget, Mc- Graw Hill.

5. Geotechnical Engineering Handbook, Robert day, Mc - Graw Hill.

6. IS 4453-1967: Code of practice for Exploration, pits, trenches, drifts & shaft, Bureau of Indian Standards, New Delhi.

7. IS 6926-1973: Code of practice for diamond drilling for site of investigation river valley project, Bureau of Indian Standards, New Delhi.

8. IS 4078-1967: Code of practice for Logging and Storage of Drilling Core, Bureau of Indian Standards, New Delhi.

9. IS 5313-1969: Guide for core drilling observation, Bureau of Indian Standards, New Delhi.

Advanced Engineering Geology with Rock Mechanics (CE24313EPR)

The students have to perform at least 07 out of 12 of the following experiments.
Oral Examination would be based on the experiments.

1. Study of geological map of India showing major rock formations and seismic zones with special reference to Maharashtra.
2. Identification and study of common rock forming minerals used in engineering works.
3. Megascopic identification and engineering uses of igneous rocks.
4. Megascopic identification and engineering uses of sedimentary rocks.
5. Megascopic identification and engineering uses of metamorphic rocks.
6. Study of geological structures such as folds, faults, joints and unconformities using models/diagrams.
7. Study of soil formation processes and identification of residual and transported soils.

7. Study of soil formation processes and identification of residual and transported soils.
8. Study of soil profile of India and factors affecting soil formation.
9. Study of water conservation techniques such as rainwater harvesting, artificial recharge and watershed development.
10. Study of geological hazards (earthquakes, landslides) and their mitigation measures.
11. Study of geophysical exploration methods used in civil engineering projects.
12. Determination of core recovery and Rock Quality Designation (RQD) from core samples.

Activity:

Assignment on each unit.

J.C. Bhong

Course Name with Code: Design of Prestressed Concrete Structures (CE24314A)		
Teaching Scheme: **TH : 3 Hrs/week** **PR : 2 Hrs/Week**	**Credits** **04** **Theory: 3** **Practical: 1**	**Examination Scheme:** **Activity: 10 Marks** **In Semester: 30 Marks** **End Semester: 60 Marks** **OR: 30 Marks**

Prerequisite: Basic knowledge of Structural Analysis, Strength of Materials, and Reinforced Concrete Design.

Course Objectives:

1. To introduce the fundamental concepts and principles of prestressed concrete and its advantages over conventional reinforced concrete.
2. To develop understanding of materials, methods of prestressing (pre-tensioning and post-tensioning), and associated systems.
3. To enable students to analyze prestress losses and their effects on structural performance.
4. To impart knowledge on the design of prestressed concrete members such as beams for flexure, shear, and deflection.
5. To understand the behavior and design of end blocks, anchorage zones, and composite sections.

Course Outcomes:

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

CO1: Understand the basic concepts, materials, systems, and methods of prestressing, and analyze prestressed members at transfer stage using stress, force, and load balancing concepts.

CO2: Analyze and evaluate various losses of prestress such as elastic shortening, creep, shrinkage, relaxation, friction, and anchorage slip.

CO3: Calculate deflection and crack width in prestressed concrete members and check serviceability limits as per relevant standards.

CO4: Design prestressed concrete sections for flexure under working and ultimate load conditions.

CO5: Analyze and design prestressed members for shear, including failure modes and provision of transverse reinforcement.

CO6: Understand different anchorage systems and design end blocks as per relevant IS codes.

Course Contents

Unit 1: Introduction to Prestressed **(07 Hours)**

Basic Concepts of Prestressing, Historical Development of prestressing, Materials and systems for prestressing, Types of Prestressing, Advantages and Limitations of Prestressing. Analysis of members at transfer - Stress Concept, Comparison of behavior of reinforced concrete – pre stressed concrete - Force concept - Load balancing concept - Kern point -Pressure line.

Unit 2: Loss of Prestress **(07Hours)**

Loss of Pre stress due to Elastic shortening, Friction, Anchorage slip, Creep of concrete, Shrinkage of concrete and Relaxation of steel - Total Loss.

Unit 3: Deflection of Prestressed Members **(07 Hours)**

Deflection and Crack Width Calculations of Deflection due to gravity loads - Deflection due to prestressing force

-Total deflection - Limits of deflection - Limits of span-to-effective depth ratio -Calculation of Crack Width - Limits of crack width.

Unit 4: Design of Sections for Flexure **(07 Hours)**

Analysis of members at ultimate strength - Preliminary Design - Final Design for Type 1members.

Unit 5: Design for Shear **(07 Hours)**

Analysis for shear - Components of shear resistance - Modes of Failure - Limit State of collapse for shear - Design of transverse reinforcement

Unit 6: Design of End Block **(07 Hours)**

Different anchorage system and design of end block by latest IS codes.

Books & Other Resources:

Text books:

1. Krishna Raju, N. "Pre stressed Concrete", Tata McGraw Hill Publishing Company, New Delhi 2006
2. Krishna Raju. N., "Pre-stressed Concrete - Problems and Solutions", CBS Publishers and Distributors, Pvt. Ltd., New Delhi.
3. Rajagopalan N, "Pre - stressed Concrete", Narosa Publishing House, New Delhi

Reference books:

1. Praveen Nagarajan, "Advanced Concrete Design", Person Publishers
2. P. Dayaratnam, "Pre stressed Concrete Structures", Scientific International Pvt. Ltd.
3. Lin T Y and Burns N H, 'Design of Pre - stressed Concrete Structures' , John Wiley and Sons, New York
4. Pundit G S and Gupta S P, "Pre - stressed Concrete", C B S Publishers, New Delhi
5. IS: 1343: Indian Standard code of practice for Pre stressed concrete, BIS, New Delhi. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, BIS, New Delhi.

Laboratory Experiments/Assignments

1. Study of prestressing systems (pre-tensioning and post-tensioning)
2. Calculation of prestress losses
3. Stress analysis of prestressed concrete sections
4. Deflection calculation of PSC members
5. Crack width calculation
6. Design of PSC beam for flexure
7. Design of PSC member for shear
8. Design of end block (anchorage zone)
9. Case study of prestressed concrete structures
10. Analysis and design of above one structure using Software

Activity: Based on the above syllabus, assignments, case studies, and model-making activities (any one) will be conducted for each unit.

CE24314B - Wastewater Engineering

Teaching Scheme:	Credits: 4	Examination Scheme:	
TH: 3 Hrs. / week	Theory: 3	Activity	: 10 Marks
PR: 2 Hrs. / week	Practical: 1	In-semester	: 30 Marks
		End semester	: 60 Marks
		OR	: 30 Marks

Prerequisite: Basic concepts of science and mathematics.

Course Objectives:

1. To understand the basic characteristics of wastewater and the design and working principle of various treatment methods.
2. To identify potential wastewater for recycle and reuse.

Course Outcomes:

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

1. Recall characteristics of wastewater and basics of sanitary sewer design.
2. Design primary wastewater treatment units.
3. Design suspended growth systems of biological treatment of wastewater.
4. Design attached growth systems of biological treatment of wastewater.
5. Recall emerging technologies of wastewater treatment.
6. Understand various sludge management systems and the potential recycle and reuse of wastewater.

Course Contents

Unit I: Quantity and Quality of Sewage **(06 Hours)**

Introduction: Wastewater Sources and flow rates, Characteristics, Standards of Disposal, Treatment Objectives and Strategies, Sanitary sewer design, Self-purification of natural streams: Oxygen sag curve, Streeter Phelps equation.

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

Layouts of Wastewater Treatment Plant, Preliminary and Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary Sedimentation tank. Design of Screens, Grit Chamber and Primary Sedimentation Tank.

Unit III: Biological Treatment- Suspended Growth System **(07 Hours)**

Unit operations and Unit Processes for secondary treatment, Role of microorganisms in wastewater treatment, Activated Sludge Process: Process Design Criteria, Oxygen and Nutrient Requirements, Classification and Design of Oxidation Ponds and Lagoons.

Unit IV: Biological Treatment- Attached Growth System **(06 Hours)**

Attached Growth Processes: Design of Trickling Filters (Standard Rate, High Rate), Biofilters, Rotating Biological Contactors, Constructed Wetlands, Phytoremediation, Root Zone Treatment Systems.

Unit V: Anaerobic Digestion and Emerging Treatment Methods **(07 Hours)**

Anaerobic sludge digestion processes, Steps in anaerobic digestion, Design of digester tank, Design of septic tank, Up-flow anaerobic sludge blanket (UASB) reactor: principle, advantages & disadvantage, applications, 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 **(07 Hours)**

Sludge management system: primary and secondary sludge, quantity and characteristics, sludge thickening, sludge dewatering, 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, USEPA

Text Books

1. Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition.
2. Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited.

Reference Books

1. Environmental Engineering, Peavy Rowe, McGraw Hill Education (India) Private Limited
2. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited.
3. Industrial Wastewater Treatment, A. D. Patwardhan, Eastern Economy Edition, PHI Learning Private Limited.
4. Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication.
5. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association.

Wastewater Engineering Lab

Term Work

The term work consists of details of at least 8 Practical. Experiment no. 10 and 11 are compulsory.

1. Determination of Dissolved Oxygen (DO).
2. Determination of Biochemical Oxygen Demand (BOD).
3. Determination of Chemical Oxygen Demand (COD).
4. Determination of Electrical Conductivity.
5. Determination of Solids – Total, Suspended, Volatile, Dissolved.
6. Determination of Sludge Volume Index.
7. Determination of nitrate by spectrophotometer.
8. Determination of phosphates by spectrophotometer.
9. Determination of heavy metals like Cu^{2+}, Zn^{2+} or Pb^{2+}.
10. Visit to domestic/Industrial wastewater treatment plant.
11. Computer aided design of Sewage Treatment Plant.

Activity: Assignments for each unit.

(CE24314CTH) – Earthquake Engineering		
Teaching Scheme:	**Credits: 4**	**Examination Scheme:**
TH: 3 Hrs./week	**Theory: 3**	**CAA: 10 Marks**
		In semester: 30 Marks
		End Semester: 60 Marks
PR: 2 Hrs./week	**Practical: 1**	**OR: 30 Marks**

Prerequisite:

1. Engineering Mechanics, Engineering Geology, Structural Design, Geotechnical Engineering, Engineering Mathematics.

Course Objectives:

1. Understand earthquake causes, seismic waves, and ground motion parameters.
2. Analyze and solve single degree of freedom vibration systems.
3. Analyze and solve multi-degree of freedom vibration systems.
4. Apply static seismic analysis methods as per IS 1893.
5. Apply dynamic seismic analysis methods as per IS 1893.
6. Design lateral load-resisting systems using seismic design principles.

Course Outcomes: After Completion of course students will be able to

CO1: Explain the causes, types of seismic waves, and ground motion parameters.

CO2: Solve single degree of freedom vibration problems.

CO3: Analyze and solve multi-degree of freedom vibration systems.

CO4: Apply static seismic analysis methods in structural design.

CO5: Apply dynamic seismic analysis techniques using IS 1893.

CO6: Design lateral load-resisting systems using seismic design principles.

Course Contents

Unit 1: Earthquake and Seismology **06 Hours**

Causes of earthquakes, types of seismic waves, magnitude and intensity, introduction to seismographs and accelerometers, key ground motion parameters such as peak acceleration, peak velocity, peak displacement, and ground motion spectra.

Unit 2: Vibration Analysis: SDOF Systems **07 Hours**

Types of vibrations, dynamic equilibrium, mathematical modeling of systems, stiffness, damping, and types of damping. Analysis of Single Degree of Freedom (SDOF) systems subjected to free vibrations.

Unit 3: Vibration Analysis: MDOF Systems **07 Hours**

Modeling and analysis of Multi-Degree of Freedom (MDOF) systems, solution methods for MDOF systems, and understanding Eigenvalues and Eigenvectors in vibration analysis.

Unit 4: Seismic Analysis: Static Approach **06 Hours**

Overview of seismic analysis, provisions in IS 1893-2016, and equivalent static analysis for buildings subjected to seismic forces.

Unit 5: Seismic Analysis: Dynamic Approach **07 Hours**

Introduction to dynamic analysis for earthquake response, provisions in IS 1893-2016, and response spectrum analysis for seismic design.

Unit 6: Seismic Design **06 Hours**

Seismic design factors, including building configuration, damping, torsion, and ductility. Lateral load-resisting systems such as moment-resisting frames, shear walls, diaphragms, and braced frames. Design provisions from IS 1893 and IS 13920 for ductile detailing of steel and concrete structures, focusing on strength and ductility of materials.

Books & Other Resources:

Textbooks

1. Structural Dynamics: Theory and Computation, Mario Paz & William Leigh, Springer Publications.
2. Earthquake Resistant Design of Structures, S. K. Duggal, Oxford Publications.
3. Earthquake Resistant Design of Structures, Pankaj Agarwal and Manish Shrikhande, Prentice Hall India Learning Private Limited.

Reference Books

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

Indian Standards

1. IS 1893 (Part 1): 2016 Reaffirmed in 2021, Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings, Bureau of Indian Standards, New Delhi, India.
2. IS 13920: 2016 Reaffirmed in 2021, Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces - Code of Practice (First Revision), Bureau of Indian Standards, New Delhi, India.

(CE24314CPR) – Earthquake Engineering

For term work submission students have to complete following practical/assignments.

Term work:

A. Experiments

1. Using any programming language or spreadsheet, plot the response functions for different types of earthquake excitations.
2. Demonstrate the applications of horizontal and vertical shake tables.
3. Perform an equivalent static seismic analysis of a multi-story building frame based on the provisions of IS 1893-2016 using suitable software.
4. Perform a dynamic seismic analysis of a multi-story building frame using the response

spectrum method as per IS 1893-2016 with suitable software.

B. Virtual Lab Experiments

1. Simple Harmonic Oscillator.
2. Free Vibration of S.D.O.F System.
3. Forced Vibration of S.D.O.F System.
4. Vibration of M.D.O.F System.
5. Concept of Response Spectrum.
6. Continuous Systems.

Activity (CAA):

Students shall complete one assignment for each of the six units as mandatory requirement under this academic activity.

CE24314D - Hydropower Engineering

Teaching Scheme:	Credits:	Examination Scheme:
TH: 3 Hrs/week	04	Activity: 10 Marks
PR: 2 Hrs/week	Theory: 03	In Semester: 30 Marks
	Practical: 01	End Semester: 60 Marks
		OR: 30 Marks

Prerequisite:

1. Basics of Fluid Mechanics, Hydrology

Course Objectives:

1. Introduce the energy resources planning and potential concept.
2. Estimate the load factor and study the power house components and layout.
3. Understand the design of hydraulic turbines and study the economic consideration of hydroelectric power.

Course Outcomes:

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

CO1: Understand the classification of power resources & trends in energy use patterns.

CO2: Identify the components of hydro power plant.

CO3: Analyze the load assessment for turbines.

CO4: Prepare the layout of power house based on the various structures need for it.

CO5: Design the turbines and surge tanks.

CO6: Understand the laws and regulatory aspects of hydroelectric power.

Course Contents

Unit 1: Hydropower Plants & Its Classification **(06 Hours)**

Introduction: sources and forms of energy, types of power plants, and elements of hydropower scheme, hydropower development in India. Power house structures-substructure and superstructure layout and dimensions, deign considerations. Hydropower plants classification: surface and underground power stations, pumped storage plants, tidal power plants, micro tidal units.

Unit II: Energy Resources and Load Assessment **(06 Hours)**

Estimation of electrical load on turbines, load factor, plant factor, peak demand and utilization factor, load curve, load duration curve, prediction of load, tariffs, hydro-thermal mix.

Unit III: Power and Energy Potential study **(06 Hours)**

Processing of hydrological data, use of extreme and long term hydrological data, mass and elevation volume curves, flow duration curves, gross and net head and estimation, reservoirs and their regulation, need for flow regulation, source of sediment, sediment yield in rivers, life of the

reservoirs, methods of fixing installed capacity of a hydropower plant, estimation of power and energy potential, mean and peak load, load curve, load factor.

Unit IV: Water Conductor System and Powerhouse **(06 Hours)**

Water conductor system, alignment, intake structures, location and types, trash rack, penstock and pressure shaft, types of powerhouses, typical layout of powerhouse, components, power plant equipment's, instrumentation and control.

Unit IV: Design of Hydraulic Turbines **(06 Hours)**

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

Unit IV: Economics of Hydroelectric Power: **(06 Hours)**

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

Books & Other Resources:

Text Books:

01 Water Power Engineering, Dandekar and Sharma, Vikas Publishin house, New Delhi

02 Water Power Engineering, R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd.

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

04 Water Power Engineering, P. K. Bhattacharya, Khanna Pub., Delhi.

Reference Books:

01 Handbook of Hydroelectric Engineering, P. S. Nigam

02 Modern Power System Planning, Wang.

03 Hydropower Resources in India, CBIP

04 Hydro Power Structures, R. S. Varshney.

05 Water Power Development. E. Mosonvi, Vol. I & II.

06 Hydro-electric Engineering Practice, G. Brown, Vol. I, II & III.

07 Hydro–Electric Handbook, Creager and Justin.

08 Centrifugal and axial flow Pump, A. J. Stephenoff, Krieger Publishing Company.

Term Work:

Term work marks will be based on continuous assessment.

01 Calculating the electricity bill of upper middle class family that uses various electrical appliances.

02 Determination of power output for a run of river plant with and without pondage.

03 Justification of economics of pumped storage plants.

04 Design of Kaplan / Francis / Pelton turbine.

05 Design of straight conical draft tube.

06 Use of any software to calculate water hammer pressure.

07 Study of any hydropower project.

08 Design of intake of a hydropower plant with neat sketch: Design of settling basin of a hydropower plant with neat sketch.

09 Hydraulic Design of Forebay and preparation of plan and longitudinal sections, Hydraulic Design of Surge Tank and preparation of plan and vertical Sections: Estimation of hydrodynamic pressure and steel thickness of penstock.

10 Report based on visit to any micro/small/mega hydropower project.

Activity

Activity shall consist of at least one of the following

1. Modelling of Hydropower Plant with specifications.
2. Case study analysis of various types of dams.

CE24314E - Solid Waste Management

Teaching Scheme:	Credits: 04	Examination Scheme:
TH: 3 Hrs./week	Theory: 04	Activity: 10 Marks
PR: 2 Hrs./week	Practical: 01	In semester: 30 Marks
		End Semester: 60 Marks
		TW: 30 Marks

Prerequisite:

1. Fundamentals of Environmental Studies, Engineering Chemistry

Course Objectives:

1. To understand problems of waste, estimate and characterize waste.
2. To apply the knowledge of mathematics, science, and engineering for effective waste collection systems and for waste collection route optimization.
3. To understand the working of waste to energy system.
4. To understand management and legal requirements of special waste, reuse, recycle and material recovery.

Course Outcomes: After Completion of course students will be able to

CO1: Apply the basics of waste management towards sustainable development.
CO2: explain methods of storage, collection and transportation of waste.
CO3: describe waste to energy systems from solid waste.
CO4: understand the process of conversion of waste to energy
CO5: understand legal requirements of special waste
CO6: understand the need of finance in waste management

Course Contents

Unit 1: Introduction to Solid Waste Management **07 Hours**

Introduction of solid waste. Functional elements, Types and sources of solid waste. Sampling and characteristics, Estimation of solid waste quantity. Factors affecting waste generation rate. 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 2: Collection and Transportation of Solid Waste **06 Hours**

Concept of integrated solid waste management and its role in efficient waste handling. Different methods of waste collection, transfer and transportation of solid waste. Application of modern technologies like Radio Frequency Identification (RFID) and Global Positioning System (GPS) for vehicle tracking and route optimization. Methods used for measuring and quantifying solid waste generation.

Unit 3: Waste to energy **06 Hours**

Basic principles of processing and treatment of municipal solid waste, including waste segregation and preparation for resource recovery. Materials recovery and recycling of useful components from

waste. Biological treatment methods such as composting and anaerobic digestion (biomethanation) for organic waste. Thermal treatment through incineration for energy recovery. Final disposal of residual waste through sanitary landfilling with environmental protection measures.

Unit 4: Source Reduction, Product Recovery & Recycling **06 Hours**

Introduction to source reduction, its purpose, benefits, and methods for minimizing solid waste generation at the source. Implementation, monitoring, and evaluation of source reduction practices. Concept and importance of product recovery and recycling in solid waste management. Planning and elements of an effective recycling programme. Overview of commonly recycled materials such as paper, plastics, glass, and metals, and their recycling processes.

Unit 5: Special Waste Management and Regulations **07 Hours**

Overview of Hazardous and Other Wastes Rules, 2016 including objectives and key provisions for handling, storage, treatment, and disposal of hazardous wastes. Concept and management of domestic hazardous waste. Introduction to management practices and regulatory frameworks for special waste streams such as E-Waste Management Rules, 2016, Biomedical Waste Management Rules, 2016, Plastic Waste Management Rules, 2016, Construction and Demolition Waste Management Rules, 2016, and Battery Waste Management Rules, 2022. Basic management approaches for nuclear waste, slaughterhouse waste, and lead battery waste including segregation, treatment, recycling, and safe disposal practices.

Unit 6: Finance and Public-Private-Partnership (PPP) in Waste Management **07 Hours**

Introduction to financing in solid waste management systems, including capital and operation costs for waste collection, transportation, treatment, and disposal. Sources of finance such as municipal budgets, government grants, user charges, loans, and revenue from waste processing. Concept, objectives, and importance of Public–Private Partnership (PPP) in improving efficiency and infrastructure development in waste management. Financing mechanisms for solid waste management projects and role of private investment.

Books & Other Resources:

Textbooks

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

Reference Books

1. Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc.,

Singapore.
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
3. Hazardous Waste Management, Charles A. Wentz, Second Edition, McGraw Hill International Edition, New York.
4. Standard Handbook of Hazardous Waste Treatment and Disposal, Harry Freeman, McGraw-Hill Education, 1998.

For term work submission students have to complete following practical/assignments.

Term work

1. Report on site visit to municipal solid waste management (Society/village/town/city).
2. Practical/theoretical identification of impacts of improper management of municipal solid waste.
3. Practical/theoretical sampling methods and characterization study of municipal solid waste.
4. Practical/theoretical estimation of solid waste generation and estimation of quantity
5. Prepare a report for management of any of the special solid wastes.
6. Prepare a report on use of smart technologies in solid waste management.
7. Determine calorific value of municipal solid waste using bomb calorimeter.
8. Determine moisture content and volatile solids for organic fraction of municipal solid waste.

Activity: Assignments for each unit.

HS24311 Democracy, Election, and Governance			
Teaching Scheme	**Credit: Non Credit Audit Course**	**Examination Scheme**	
TH 01 Hrs/Week		Course Activity:	NIL
		End Semester:	NIL
	TH Credit :NIL	Total	NIL

Course Objective:

The primary objectives of this course are to:

- Analyze the structure and role of democratic institutions
- Understand the electoral process and the role of the Election Commission of India,
- Study the framework of governance in India, covering the executive, legislative, and judicial branches at both central and state levels.

Course Outcomes:

At the end of the course, students will be able

CO1: Explain the evolution and significance of democracy in India, its core principles, and its role in nation-building

CO2: Describe the composition, powers, and functions of the Election Commission of India, and understand the electoral process

CO3: Interprete the governance structures at the Union and State levels, covering executive, legislative, and judicial functions

Course Contents		
Mapping of Course Outcomes for Unit I	**CO1**	
UNIT I	**Democracy in India**	**05 Hours**

Evolution of Democracy, Dimensions of Democracy: Social, Economic and Political, Decentralisation: Grassroots Level Democracy, Challenges before Democracy: women and marginalized sections of the society

Mapping of Course Outcomes for Unit II	**CO2**	
UNIT II	**Election**	**04 Hours**

Election Commission of India-composition, powers and functions, and electoral process. Types of emergency grounds, procedure, duration, and effects. Amendment of the constitution- meaning, procedure, and limitations

Mapping of Course Outcomes for Unit III	**CO3**	
UNIT III	**Governance**	**04 Hours**

Union Executive- President, Vice-president, Prime Minister, Council of Ministers. Union Legislature-Parliament and Parliamentary proceedings. Union Judiciary-Supreme Court of India – composition and powers and functions.

State Executive- Governor, Chief Minister, Council of Ministers. State Legislature-State Legislative Assembly and State Legislative Council. State Judiciary-High court. Local Government- Panchayat raj system Challenges of caste, gender, class, democracy and ethnicity

Books and Other Resources

Text and Reference Books:

1. Banerjee-Dube, I. (2014). A history of modern India. Cambridge University Press.
2. Bhargava, R. (2008). Political theory: An introduction. Pearson Education India.
3. Bhargava, R., Vanaik, A. (2010) Understanding Contemporary India: Critical Perspective. New Delhi: Orient Blackswan.
4. Chandhoke. N., Proyadardhi.P, (ed) (2009), 'Contemporary India: Economy, Society, Politics', Pearson India Education Services Pvt. Ltd, ISBN 978-81- 317-1929-9.
5. Chandra, B. (1999). Essays on contemporary India. Har-Anand Publications.
6. Chaterjee, P. (1997). State and Politics in India.
7. Dasgupta. S., (ed) (2011), 'Political Sociology', Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education in south Asia. ISBN: 978-317-6027- 7.
8. Deshpande, S. (2003). Contemporary India: A Sociological View, New Delhi:Viking Publication.
9. Guha, R. (2007). India After Gandhi: The History of the World's Largest. Democracy, HarperCollins Publishers, New York.
10. Guha, R. (2013). Gandhi before India. Penguin UK.
11. Jayal. N.G. (2001). Democracy in India.New Delhi: Oxford University Press.
12. Kohli, A. (1990). Democracy and discontent: India's growing crisis of governability. Cambridge University Press.
13. Kohli, A., Breman, J., & Hawthorn, G. P. (Eds.). (2001). The success of India's democracy (Vol. 6). Cambridge University Press.
14. Kothari, R. (1989). State against democracy: In search of humane governance. Apex Pr.
15. Kothari, R. (1970). Politics in India. New Delhi: Orient Blackswan.
16. Kothari, R. (1995). Caste in Indian politics. Orient Blackswan.
17. Sarkar, S. (2001). Indian democracy: the historical inheritance. the Success of India's Democracy, 23- 46

Evaluation and Assessment

Since this is an audit course, evaluation will be based on active participation, understanding of concepts, and analytical skills:

- Assignments & Reports – Writing assignments on topics like electoral reforms, democratic challenges, or constitutional amendments.
- Quizzes/MCQs – Multiple-choice or short-answer questions covering key topics like the Election Commission, parliamentary proceedings, and governance.
- Group Discussions/Presentations– Debates on issues like democracy and social justice, governance challenges, and the effectiveness of grassroots-level democracy.