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SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti – 626 115

(An Autonomous Institution)

DEPARTMENT OF CIVIL ENGINEERING

B.E Civil Engineering

Curriculum & Syllabus

Regulation 2021[Batch – 2022-2026]

Choice Based Credit System

Approved in the

Academic Council Meeting on 20.05.2024

Chairperson / BoS **Chairman**
Academic Council

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SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti – 626 115

(An Autonomous Institution)

DEPARTMENT OF CIVIL ENGINEERING

Department Vision statement

To achieve excellence in technical education and research in Civil Engineering field for the betterment of the society.

Department Mission Statement

1. Fulfilling the aspiration of the students by providing quality technical educational experiences to meet the needs of the industry.
2. Providing comprehensive learning environment
3. Imparting employability and entrepreneurial skills
4. Establishing industrial collaborations
5. Promoting Research and Development activities in emerging areas of Civil Engineering
6. Serving the society through quality education, technology and consultancy

Program Educational Objectives (PEOs)

AfterfewyearsofgraduationourMechanicalEngineeringgraduatesareexpected to:	
PEO I	Demonstrate expertise in offering solutions in civil Engineering field (**Core Competence)**
PEO II	Exhibit professional skills to function effectively with ethical principles.**(Professional and Ethical Skills)**
PEO III	Engage in perpetual learning and research with social responsibility.**(Lifelong Learning)**

PROGRAM OUTCOMES (POs):	
1.	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
4.	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5.	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and Modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7.	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8.	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PROGRAM SPECIFIC OUTCOMES (PSOs):	
The Civil Engineering Graduates will be able to:	
1.	Design, Create and maintain safe and cost effective Structural systems
2.	Design Hydraulic and Water supply systems with environmental concerns for sustainable development

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B.E. CIVIL ENGINEERING
CURRICULUM -Regulations 2021
[Batch – 2022-2026]

CHOICE BASED CREDIT SYSTEM

OVERALL COURSE STRUCTURE

Code	Category	Total No. of Courses	Credits	Percentage
BS	Basic Sciences	10	28	17.17
ES	Engineering Sciences	7	18	11.04
HSS	Humanities and Social Sciences	5	9	5.52
PC	Professional Core(Including Lab Courses)	23	60	36.80
PE	Professional Electives	6	18	11.04
OE	Open Electives	4	12	7.36
PW	Project Work, Seminar & Internship	4	16	9.87
MC	Mandatory Courses	10	2	1.20
	TOTAL	**69**	**163**	**100**

COURSE CREDITS – SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
Civil Engineering	**22**	**18**	**23**	**22**	**23**	**24**	**17**	**14**	**163**

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SEMESTER– I

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
1.	21UEN101	English for Technical Communication (Common to All Branches – Except CSBS)	2	0	0	2	HSS
2.	21UMA102	Matrix and Calculus (Common to All Branches – Except CSBS)	3	1	0	4	BS
3.	21UPH103	Engineering Physics (Common to All Branches – Except CSBS)	3	0	0	3	BS
4.	21UCY106	Chemistry for Civil Engineers (Only for Civil)	3	0	0	3	BS
5.	21UCS107	Problem Solving and C Programming (Common to All Branches)	3	0	0	3	ES
6.	21UME109	Engineering Graphics (Common to All Branches – Except CSBS, CSD and AI&DS)	3	1	0	4	ES
PRACTICAL							
7.	21UCS111	Problem Solving and C Programming Laboratory (Common to All Branches – Except CSBS)	0	0	2	1	ES
8.	21UME111	Engineering Practices Laboratory (Common to Mech, EEE, Civil, Agri and Chemical)	0	0	2	1	ES
9.	21UGS113	Basic Sciences Laboratory I (Common to All Branches – Except CSBS)	0	0	2	1	BS
MANDATORY COURSE							
10.	21UGM131	Induction Programme (45 periods) (Common to All Branches)	0	3	0	P/F	MC
		TOTAL	**17**	**5**	**6**	**22**	
							Total No. of Credits – 22

SEMESTER– II

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
11.	21UEN201	Communication Skills for Professionals (Integrated Course) (Common to All Branches – Except CSBS)	1	0	1	1.5	HSS
12.	21UMA206	Differential Equations, Complex Analysis and Transform Techniques (Only for Civil)	3	1	0	4	BS

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13.	21UPH206	Building Physics (Only for Civil)	3	0	0	3	BS
14.	21UCE204	Engineering Mechanics (Only for Civil)	3	0	0	3	ES
15.	21UEE226	Basic Electrical and Electronics Engineering (Common to Civil and Mechanical)	3	0	0	3	ES
PRACTICAL							
16.	21UGS210	Basic Sciences Laboratory II (Common to All Branches – Except CSBS)	0	0	2	1	BS
17.	21UCE211	Computer Aided Building Drawing (Only for Civil)	0	0	3	1.5	ES
MANDATORY COURSE							
18.	21UGM331	Biology for Engineers (Common to All Branches – Except BT and BME)	3	0	0	P/F	MC
19.	21UGT140	Heritage of Tamil (Common to All Branches)	1	0	0	1	MC
		TOTAL	**16**	**1**	**6**	**17**	
							Total No. of Credits – 17

SEMESTER– III

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
20.	21UMA325	Probability, Statistics and Transform Techniques (Only for Civil)	3	1	0	4	BS
21.	21UCE302	Engineering Geology and Construction Materials	3	0	0	3	ES
22.	21UCE303	Strength of Materials	3	1	0	4	PC
23.	21UCE304	Water Supply Engineering	3	0	0	3	PC
24.	21UCE305	Fluid Mechanics	3	0	0	3	PC
25.	21UCE306	Surveying	3	0	0	3	PC
PRACTICAL							
26.	21UCE307	Material Testing Laboratory	0	0	3	1	PC
27.	21UCE308	Surveying Laboratory	0	0	3	1	PC
MANDATORY COURSE							
28.	21UGM231	Environmental Science (Common to All Branches)	2	0	0	P/F	MC
29.	21UGT241	Tamil and Technology (Common to All Branches)	1	0	0	1	MC
		TOTAL	**21**	**2**	**6**	**23**	
							Total No. of Credits – 23

SEMESTER– IV

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
30.	21UMA423	Numerical Methods (Only for Civil)	3	1	0	4	BS
31.	21UCE402	Soil Mechanics	3	0	0	3	PC
32.	21UCE403	Structural Analysis – I	3	1	0	4	PC
33.	21UCE404	Waste Water Engineering	3	0	0	3	PC
34.	21UCE405	Highway Engineering	3	0	0	3	PC
35.	21UCE406	Applied Hydraulic Engineering	3	0	0	3	PC
PRACTICAL							
36.	21UCE407	Water and Waste Water Analysis Laboratory	0	0	3	1	PC
37.	21UCE408	Hydraulic Engineering Laboratory	0	0	3	1	PC
MANDATORY COURSE							
38.	21UGM431	Gender Equality (Common to All Branches)	1	0	0	P/F	MC
		TOTAL	**19**	**2**	**6**	**22**	
							Total No. of Credits – 22

SEMESTER– V

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
39.	21UCE501	Structural Analysis – II	3	1	0	4	PC
40.	21UCE502	Foundation Engineering	3	0	0	3	PC
41.	21UCE503	Design of Reinforced Concrete Elements	3	1	0	4	PC
42.		Professional Elective – I	3	0	0	3	PE
43.		Open Elective – I	3	0	0	3	OE
PRACTICAL							
44.	21UCE507	Creative Thinking and Innovation	0	0	2	1	PW
45.	21UCE508	Soil Mechanics Laboratory	0	0	3	1.5	PC
46.	21UCE509	Survey Camp (4^{th} Semester Summer Vacation - 2 Weeks)	0	0	0	2	PW
47.	21UGS533	Interpersonal Skills Laboratory (Common to Mech. Civil, BT and BME)	0	0	3	1.5	HSS
		TOTAL	**15**	**2**	**8**	**23**	
							Total No. of Credits – 23

SEMESTER– VI

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
48.	21UCE601	Concrete Technology (Integrated Course)	2	0	3	4	PC
49.	21UCE602	Design of Steel Structures	3	1	0	4	PC
50.		Professional Elective – II	3	0	0	3	PE
51.		Professional Elective – III	3	0	0	3	PE
52.		Open Elective – II	3	0	0	3	OE
53.	21UGS631	Logical Reasoning & Aptitude (Common to Civil, BT and BME)	1	0	0	1	BS
PRACTICAL							
54.	21UCE607	Product Development Project	0	0	8	4	PW
55.	21UCE608	Highway Engineering Laboratory	0	0	3	1	PC
56.	21UGS632	Soft Skills and Communication Laboratory	0	0	3	1	HSS
MANDATORY COURSE							
57.	21UGM631	Indian Constitution (Common to All Branches)	1	0	0	P/F	MC
		TOTAL	**17**	**1**	**15**	**24**	
							Total No. of Credits – 24

SEMESTER– VII

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
58.	21UME701	Project Management and Finance (Common to all except CSBS)	3	0	0	3	HSS
59.	21UCE702	Estimating and Costing	3	0	0	3	PC
60.		Professional Elective – IV	3	0	0	3	PE
61.		Professional Elective – V	3	0	0	3	PE
62.		Open Elective – III	3	0	0	3	OE
PRACTICAL							
63.	21UCE707	Structural Design Software Laboratory	0	0	3	1	PC
64.	21UGE710	Multi-Disciplinary Project (Phase I)	0	0	6	3	PW
65.	21UCE735	Internship Training	0	0	0	1	PW
MANDATORY COURSE							
66.	21UGM731	Sports and Social Development (Common to All Branches)	-	-	-	P/F	MC
67.	21UGM732	Skill Development(Common to All Branches)	-	-	-	P/F	MC
		TOTAL	**15**	**0**	**3**	**17**	
							Total No. of Credits – 17

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SEMESTER– VIII

S. No	Course Code	Name of the Course	L	T	P	C	Category
THEORY							
68.		Professional Elective – VI	3	0	0	3	PE
69.		Open Elective – IV	3	0	0	3	OE
PRACTICAL							
70.	21UCE801	Project Work	0	0	16	8	PW
71.	21UGE810	Multi-Disciplinary Project (Phase II)	0	0	16	8	PW
MANDATORY COURSE							
72.	21UGM831	Professional Ethics and Human Values (Common to All Branches)	2	0	0	P/F	MC
		TOTAL	**8**	**0**	**16**	**14**	
							Total No. of Credits – 14

LIST OF MANDATORY COURSES

S. No.	Course Code	Name of the Course	L	T	P	C
1.	21UGM131	Induction Program	0	3	0	P/F
2.	21UGT140	Heritage of Tamil	1	0	0	1
3.	21UGT141	Tamil and Technology	1	0	0	1
4.	21UGM231	Environmental Science	2	0	0	P/F
5.	21UGM331	Biology for Engineers	3	0	0	P/F
6.	21UGM431	Gender Equality	1	0	0	P/F
7.	21UGM631	Indian Constitution	1	0	0	P/F
8.	21UGM731	Sports and Social Development	-	-	-	P/F
9.	21UGM732	Skill Development	-	-	-	P/F
10.	21UGM831	Professional Ethics and Human Values	2	0	0	P/F

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VERTICALS (PROFESSIONAL ELECTIVE COURSES)

VERTICAL I: STRUCTURES

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV101	Design of Concrete Structures	3	0	0	3	PE
2.	21CEV102	Masonry Structures	3	0	0	3	PE
3.	21CEV103	Prefabricated Structures	3	0	0	3	PE
4.	21CEV104	Prestressed Concrete Structures	3	0	0	3	PE
5.	21CEV105	Repair and Rehabilitation of Structures	3	0	0	3	PE
6.	21CEV106	Structural Dynamics and Earthquake Engineering	3	0	0	3	PE
7.	21CEV107	Finite Element Methods	3	0	0	3	PE
8.	21CEV108	AI for Civil Engineering and Machine Learning	3	0	0	3	PE

VERTICAL II: CONSTRUCTION TECHNIQUES AND PRACTICES

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV201	Formwork Engineering	3	0	0	3	PE
2.	21CEV202	Construction Equipment and Machinery	3	0	0	3	PE
3.	21CEV203	Sustainable Design	3	0	0	3	PE
4.	21CEV204	Digitalized ConstructionLab	3	0	0	3	PE
5.	21CEV205	Construction Managementand Safety	3	0	0	3	PE
6.	21CEV206	Advanced ConstructionTechniques	3	0	0	3	PE
7	21CEV207	Energy Efficient Buildings	3	0	0	3	PE

VERTICAL III: GEOTECHNICAL

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV301	Geo-Environmental Engineering	3	0	0	3	PE
2.	21CEV302	Ground Improvement Techniques	3	0	0	3	PE
3.	21CEV303	Soil Dynamics and Machine Foundations	3	0	0	3	PE
4.	21CEV304	Rock Mechanics	3	0	0	3	PE
5.	21CEV305	Earth retaining structures	3	0	0	3	PE
6.	21CEV306	Pile foundation	3	0	0	3	PE
7.	21CEV307	Tunneling Engineering	3	0	0	3	PE

VERTICAL IV GEO-INFORMATICS

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV401	Modern Surveying	3	0	0	3	PE
2.	21CEV402	Application of Remote Sensing	3	0	0	3	PE

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3.	21CEV403	Satellite Image Processing	3	0	0	3	PE
4.	21CEV404	Cartography and GIS	3	0	0	3	PE
5.	21CEV405	Photogrammetry	3	0	0	3	PE
6.	21CEV406	Airborne and Terrestrial laser mapping	3	0	0	3	PE
7.	21CEV407	Hydrographic Surveying	3	0	0	3	PE

VERTICAL V: TRANSPORTATION INFRASTRUCTURE

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV501	Railway Airport and Harbour Engineering	3	0	0	3	PE
2.	21CEV502	Traffic Engineering and Management	3	0	0	3	PE
3.	21CEV503	Urban Planning and Development	3	0	0	3	PE
4.	21CEV504	Smart City Technologies	3	0	0	3	PE
5.	21CEV505	Intelligent Transport systems	3	0	0	3	PE
6.	21CEV506	Pavement Engineering	3	0	0	3	PE
7.	21CEV507	Housing Planning and Management	3	0	0	3	PE

VERTICAL VI: ENVIRONMENT

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV601	Climate Change Adaptation and Mitigation	3	0	0	3	PE
2.	21CEV602	Air and Noise Pollution Control Engineering	3	0	0	3	PE
3.	21CEV603	Environmental ImpactAssessment	3	0	0	3	PE
4.	21CEV604	Industrial WastewaterManagement	3	0	0	3	PE
5.	21CEV605	Municipal Solid Waste Management	3	0	0	3	PE
6.	21CEV606	Environmental Laws and Policies	3	0	0	3	PE
7.	21CEV607	Environment, Health andSafety	3	0	0	3	PE

VERTICAL VII: WATER RESOURCES

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV701	Water Resources Management	3	0	0	3	PE
2.	21CEV702	Groundwater Engineering	3	0	0	3	PE
3.	21CEV703	Water Resources and Irrigation Engineering	3	0	0	3	PE
4.	21CEV704	Watershed Conservation and Management	3	0	0	3	PE
5.	21CEV705	Integrated Water Resources Management	3	0	0	3	PE
6.	21CEV706	Urban Water Infrastructure	3	0	0	3	PE
7.	21CEV707	Water Quality and Management	3	0	0	3	PE

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VERTICAL VIII: OCEAN ENGINEERING

S. No	Course Code	Name of the Course	L	T	P	C	Category
1.	21CEV801	Ocean Wave Dynamics	3	0	0	3	PE
2.	21CEV802	Marine Geotechnical Engineering	3	0	0	3	PE
3.	21CEV803	Coastal Engineering	3	0	0	3	PE
4.	21CEV804	Off shore Structures	3	0	0	3	PE
5.	21CEV805	Port and Harbour Engineering	3	0	0	3	PE
6.	21CEV806	Coastal Hazards and Mitigation	3	0	0	3	PE
7.	21CEV807	Coastal Zone Management and Remote Sensing	3	0	0	3	PE

COMMONVERTICALSFORALLDEPARTMENTS

Vertical IFintech and Block Chain	Vertical II Entrepreneurship	Vertical III Public Administration
21CBVG11FinancialManagement	21MEVG21FoundationsofEntrepreneurship	21EEVG31 Principles of Public Administration
21CBVG12 Fundamentals of Investment	21MEVG22 Team Building and Leadership Management for Business	21EEVG32IndianEconomy
21CBVG13 Banking, Financial Services and Insurance	21MEVG23 Creativity and Innovation in Entrepreneurship	21EEVG33 Public Personnel Administration
21CBVG14 Introduction to Blockchain and its Applications	21MEVG24PrinciplesofMarketing Management for Business	21EEVG34Administrative Theories
21CBVG15 Fintech Personal Finance and Payments	21MEVG25 Human Resource Management for Entrepreneurs	21EEVG35IndianAdministrative System
21CBVG16 Introduction to Fintech	21MEVG26FinancingNewBusinessVentures	21EEVG36 Public Policy Administration

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VerticalIV BusinessDataAnalytics	VerticalV EnvironmentandSustainability	Vertical VI ComputerTechnology
21CSVG41 Statistics for Management	21CEVG51 Sustainable Infrastructure Development	21ITVG61ObjectOrientedProgramming using C++
21CSVG42 Data Mining for Business Intelligence	21CEVG52 Sustainable Agriculture and Environmental Management	21ITVG62AlgorithmsandData Structures
21CSVG43 Human Resource Analytics	21CEVG53SustainableBioMaterials	21ITVG63JavaFundamentals
21CSVG44 Marketing and Social Media Web Analytics	21CEVG54 Materials for Energy Sustainability	21ITVG64AgileSoftwareDevelopment
21CSVG45 Operation and Supply Chain Analytics	21CEVG55GreenTechnology	21ITVG65DatabaseandDataAnalytics
21CSVG46FinancialAnalytics	21CEVG56 Environmental Quality Monitoring and Analysis	21ITVG66NetworkingandData Communication
	21CEVG57IntegratedEnergyPlanningfor Sustainable Development	21ITVG67 Applications Development (Full Stack)
	21CEVG58 Energy Efficiency for SustainableDevelopment	21ITVG68MachineLearning
		21ITVG69CyberSecurity

LIST OF OPEN ELECTIVES

S. No.	Course Code	Name of the Course	L	T	P	C
1.	21UCE971	Development of smart cities	3	0	0	3
2.	21UCE972	Remote Sensing and GIS Applications	3	0	0	3
3.	21UCE973	Disaster Management and Mitigation	3	0	0	3
4.	21UCE974	Air Pollution and Control Engineering	3	0	0	3
5	21UCE975	Environmental and Social Impact Assessment	3	0	0	3
6	21UCE976	Road Safety	3	0	0	3
7	21UCE977	Solid Waste Management	3	0	0	3

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LIST OF ONE CREDIT COURSES (WITH INDUSTRY COLLABORATION)

S. No.	Course Code	Name of the Course	L	T	P	C
1.	21UCE861	Green Building Concepts	1	0	0	1
2.	21UCE862	Design of Scaffolding	1	0	0	1
3.	21UCE863	Water Conservation Techniques	1	0	0	1
4.	21UCE864	Construction Safety	1	0	0	1
5.	21UCE865	Effluent Treatment Plant	1	0	0	1
6.	21UCE866	Corrosion of Steel in Concrete and Preventive Measures	1	0	0	1
7.	21UCE867	Building Planning and Byelaws	1	0	0	1
8.	21UCE868	Automation in Construction	1	0	0	1
9.	21UCE869	Building Energy Audit	1	0	0	1
10.	21UCE870	Health Monitoring of Structures	1	0	0	1
11.	21UCE871	Artificial Intelligence in Civil Engineering	1	0	0	1
12.	21UCE872	Practical Aspects of Architecture.	1	0	0	1
13.	21UCE873	Applications of Robotics in Civil Engineering	1	0	0	1
14.	21UCE874	Drone surveying	1	0	0	1
15.	21UCE875	Recycled Construction Materials	1	0	0	1
16.	21UCE876	Practical Building Information Modeling	1	0	0	1
17.	21UCE877	Building Safety	1	0	0	1
18.	21UCE878	Bar Bending and Ductile detailing	1	0	0	1
19.	21UCE879	Global Climate Change and Vulnerability Assessment	1	0	0	1
20.	21UCE880	Paver Block Manufacturing as per IS code	0	0	2	1

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I SEMESTER

21UEN101	ENGLISH FOR TECHNICAL COMMUNICATION (Common to All Branches- except CSBS)	L	T	P	C
		2	0	0	2

Course Learning Objectives:

- To enhance the vocabulary of students.
- To strengthen the application of functional grammar and basic skills.
- To improve the language proficiency of students.

Unit I		**8**

Listening –Formal and informal conversations and comprehension. Speaking- introducing oneself – exchanging personal and social information-Reading – Skimming and Scanning. Writing–Sentence Formation, Formal Letters (Permission/Requisition) - Grammar - Parts of Speech - Tense - Vocabulary Development – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms-Phrases and Clauses.

Unit II		**8**

Listening– Telephonic Conversations. Speaking– Pronunciation rules with Stress pattern. Reading – comprehension-pre-reading, post-reading- comprehension questions Writing – Punctuation rules, paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions, Precise writing, Developing Hints - Report Writing (Industrial, Accident)- Grammar – Voice Vocabulary Development- Words from other languages in English.

Unit III		**7**

Listening – Motivational speech by Great Speakers Speaking–Narrating daily events -retelling short stories. Reading – Newspaper reading. Writing – Job application letter - Transformation of Information (Transcoding)– Grammar Subject-Verb Agreement (Concord),— Vocabulary Development –Same word in different parts of speech.

Unit IV		**7**

Listening – Understating the instruction. Speaking-Intonation and preparing dialogue on various formal and informal situation Reading –Note Making from given text - Writing–Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) -Grammar–Spot the Errors in English, Vocabulary Development– One word substitution.

TOTAL = 30 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Exhibit reading skills and comprehension to express the ideas in the given text.	Understand
CO.2	Apply grammar effectively in writing meaningful sentences and paragraphs.	Apply
CO.3	Develop writing skills to present the ideas in various formal situations.	Create
CO.4	Develop oral fluency to express the ideas in various formal situations.	Create
CO.5	Exhibit writing skills to prepare reports for various purposes.	Create

Text Books:

1. KN Shoba, Lourdes Joavani Rayen, Communicative English, New Delhi, Cambridge University Press, 2017.

21UMA102	MATRIX AND CALCULUS (Common to All Branches-Except CSBS)	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases.
- To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions.
- To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field.

Unit I	MATRICES	8 + 3

Eigen value and eigenvector of a real matrix – Characteristic equation – Properties – Cayley- Hamilton theorem (excluding Proof) – Orthogonal reduction – (transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation..

Unit II	DIFFERENTIAL CALCULUS	9 + 3

Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (nth derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling– Heat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems).

Unit III	FUNCTIONSOFSEVERAL VARIABLES	9 + 3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers.

Unit IV	INTEGRAL CALCULUS	8 + 3

Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions

Unit V	MULTIPLE INTEGRALS	8 + 3
Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates – Volume as triple integral.		
SUPPLEMENT TOPIC (for internal evaluation only)		**3**
Evocation /Application of Mathematics, Quick Mathematics – Speed Multiplication and Division Applications of Matrices.		
		TOTAL : 45 (L) + 15 (T) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concept in Matrix, Differentiation and Integration. ()	Understand
CO.2	Analyze functions using limits, continuity, derivatives and to solve Physical application problems.	Analyze
CO.3	Apply differentiation techniques and Lagrange multiplier method to predict the extreme values of the functions with constraints.	Apply
CO.4	Apply the concept of some special function like Gamma, Beta function and their relation to evaluate some definite integral.	Apply
CO.5	Apply integration to compute Multiple integrals, Area and Volume in addition to change of order and change of variables.	Apply
CO.6	Apply the Characteristic Equation, Characteristic roots and use the applicability of Cayley – Hamilton theorem to find the Inverse of matrix.	Apply

Text Books:

1. BALI N. P and MANISH GOYAL, “A Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd, New Delhi, 8th Edition, (2011).
2. VEERARAJAN.T “Engineering Mathematics” Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. GREWAL. B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 42nd Edition, (2012).

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Reference Books:

1. RAMANA B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. GLYN JAMES, “Advanced Engineering Mathematics”, Pearson Education, New Delhi, 7th Edition, (2007).
3. JAIN R.K and IYENGAR S.R.K,” Advanced Engineering Mathematics”, Narosa Publishing House, New Delhi, 3rd Edition, (2007).
4. BHARATI KRISHNA TIRTHAJI, “Vedic Mathematics - Mental Calculation”, MotilalBanarsiDass Publications, New Delhi, 1st Edition, (1965).
5. KREYSZIG. E, “Advanced Engineering Mathematics”, John Wiley & Sons, New York, 10th Edition, (2011).
6. P.SIVARAMAKRISHNA DAS, E.RUKMANGADACHARI “Engineering mathematics”, volume 1, Pearson Edison New Delhi, 2nd Edition, (2013).

21UPH103	ENGINEERING PHYSICS (Common to All B.E/B.Tech Branches-Except CSBS)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To develop the research interest in crystal physics.
- To use the principles of Lasers and its types.
- To apply principles of Quantum physics in engineering field.
- To develop knowledge on properties of materials.

Unit I	CRYSTAL STRUCTURE	9

Introduction – Classification of solids –Space lattice –Basis-Lattice parameter – Unit cell– Crystal system – Miller indices –d-spacing in cubic lattice - Calculation of number of atoms per unit cell – Atomic radius- Coordination number – Packing factor for SC, BCC, FCC and HCP structures - Applications.

Unit II	SOLID DEFECTS AND HOLOGRAPHY	9

Introduction – Solid defects - Crystal imperfection –Point defects-Line defects-Surface defects-Volume defects Burger vector –Holography–Construction and Reconstruction of hologram – Industrial and Medical Applications

Unit III	PHOTONICS	9

Introduction- Principles of Laser- Characteristics of laser -Spontaneous and stimulated emission –Population inversion – Einstein's A and B coefficients - Pumping methods – Basic components of Laser - Types of lasers – Nd -YAG laser - CO2 laser –Holography –Construction and Reconstruction of hologram – Industrial and Medical Applications.

Unit IV	INTRODUCTION TO QUANTUM MECHANICS	9

Introduction - Black body radiation – Planck's law of radiation - Wien's displacement law- Rayleigh Jeans law- – Compton Effect – Theory and experimental verification – Matter waves- Schrodinger's wave equation – Time dependent – Time independent equation – Particle in 1-D dimensional box.

Unit V	PROPERTIES OF SOLIDS	9

Introduction - Elasticity- Stress and Strain - Hooke's law – Three moduli of elasticity –stress- strain curve – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending –I- shaped girders.

TOTAL = 45 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Classify the types of crystals, lasers and elastic behavior of solids.	Understand
CO.2	Apply the basic knowledge of crystal, quantum mechanics and mechanical behavior of solids to solve engineering problems.	Apply
CO.3	Apply the principle of laser to estimate the wavelength of emitted photons.	Apply
CO.4	Analyze the dual nature of matter using the concepts of quantum mechanics.	Analyze
CO.5	Analyze the structural and optical properties of crystals in industrial and medical applications.	Analyze
CO.6	Analyze the structural and optical properties of materials for specific Engineering Applications.	Analyze

Text Books:

1. Dr. Mani.P, “Engineering Physics”, Dhanam Publications, Edition ,2018, Chennai.
2. Rajendran.V, “Engineering,Physics”, Tata Mc-Graw Hill Publishing Company limited,
3. New Delhi, Revised Edition 2018.

Reference Books:

1. Raghuvenshi G.S., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2018.
2. Arul doss .G., “Engineering Physics”, PHI Learning Limited, New Delhi, Revised Edition 2018.
3. Marikani .A., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2017.
4. Sankar B.N., and Pillai .S.O., “A Text book of Engineering Physics”, New Age International Publishers Private Limited, New Delhi, Revised Edition 2017. \
5. Avadhanulu M.N. and Kshirsagar P.G., “A Textbook: of Engineering Physics”, S.Chand& Company Ltd., New Delhi, 2018

21UCY106	CHEMISTRY FOR CIVIL ENGINEERS (Civil Engineering)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To explain the boiler feed water requirements related problems and water treatment techniques.
- To impart the knowledge on basics and applications of spectroscopy.
- To explain the principles and applications of corrosion.
- To explain the applications of refractories, ceramics and cements..

Unit I	WATER AND ITS TREATMENT TECHNOLOGIES	9

Hardness of water – types – expression of hardness (Problems) – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment - Ion exchange process- zeolite process – desalination of brackish water – Reverse Osmosis

Unit II	CORROSION AND ITS PREVENTION TECHNIQUES	9

Introduction- Definition- Types –Chemical corrosion (Dry corrosion, mechanism and its Example)- Electrochemical corrosion (Wet corrosion, mechanism and its Types – Galvanic & Differential aeration Corrosion- Pitting, crevice & Wire fence corrosion). Corrosion prevention
-Protective coatings – Paint, Electro plating – Gold plating.

Unit III	INSTRUMENTATION FOR ANALYTICAL METHODS	9

Spectroscopy - need and timeline - Beer-Lamberts law - Principle, instrumentation and applications –UV-Visible spectrophotometer- X-ray diffract meter – Atomic Absorption spectroscopy (AAS) - Scanning Electron Microscopy (SEM), Transition Electron Microscopy (TEM)- Gas Chromatography- HPLC and Mass Spectrometry- Principal and application.

Unit IV	REFRACTORIES, CERAMICS AND CEMENT	9

Refractories: Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, and porosity.Classification acidic, basic and neutral refractories, manufacture and uses of alumina, magnesite and zirconia brick

Unit V	CERAMICS AND CEMENT	9

Ceramics: Clays, silica, Feldspars- preparation, properties and uses. Methods for fabrication of ceramic wares-ceramic products; structural clay products, white wares, earthern wares.

Cement: Portland cement- Composition, manufacture and properties – setting and hardening of cement, special cement- waterproof and white cement properties and uses.

TOTAL = 45 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concept of chemistry involved in water treatment methods, corrosion types, instrumental methods and constructional materials.	Understand
CO.2	Apply the properties of refractories, cement and ceramics suitable for building.	Apply
CO.3	Analyze the impurities of water to find its hardness and remove the hardness causing substances.	Analyze
CO.4	Analyze the causes of corrosion, its consequences and methods to minimize corrosion to improve industrial designs.	Analyze
CO.5	Analyse the compounds by using different spectroscopic methods.	Analyze

Text Books:

1. Jain P.C. and Monica Jain, "Engineering Chemistry",Dhanpat Rai Publishing Company(P) Ltd., New Delhi,2010.
2. MichaelS. Mamlouk, John P.Zaniewski,"Materials For Civil and Construction Engineers" Third Edition, Prentice Hall, Newyork, USA.
3. Pradeep.T"AtextbookofNanoscienceandNanotechnology",TataMcGraw-Hilleducation private ltd,2012.

Reference Books:

1. Physical chemistry – Samuel Glasstone, Macmillan II edition,1969.
2. A.K.Kaw, Mechanics of Composite Materials, CRCPress, NewDelhi 2005.
3. S.C.Sharma, Composite materials, Narosa Publications, NewDelhi, 2000.
4. Bolt, G.H, Bruggen wert, M.G.M, 1978, soil chemistry, Elsevier.

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21UCS107	PROBLEM SOLVING AND C PROGRAMMING (Common to ALL Branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impact the concepts in basic organization of computers and problem solving techniques
- To familiarize the programming constructs of C
- To explain the concepts of arrays, strings, functions, pointers, structures and unions in C.

Unit I	INTRODUCTION	8

Generation and Classification of computers – Basic Organization of a Computer – Problem formulation – problem Solving – Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

Unit II	C PROGRAMING BASICS	9

Introduction to 'C' programming – fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' managing Input and Output operations.

Unit III	DECISION MAKING AND LOOPING STATEMENTS	10

If – If else- nested if else – else – if ladder statement – switch – go to – for – while – do –while – break – continue statements – problem solving with decision making and looping statements.

Unit IV	ARRAYS, STRINGS AND FUNCTIONS	9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays – String – Sting operations – string arrays – Function – definition of function – Declaration of function – Parameter passing methods – Recursion – Storage lasses – Problem solving with arrays, strings and functions.

Unit V	POINTERS, STRUCTURES AND UNIONS	9

Pointers – Definition – Initialization – Pointers arithmetic – Pointers and arrays – Dynamic Memory allocation – Structure with in a structure – Union – Pre – processor directives.

TOTAL :45 PERIODS

Course Outcomes:

After the successful completion of the course, the Students will be able to

- Illustrate the basics about computer.
- Develop simple programs using branching and looping constructs.
- Write C program to manage data using arrays.
- Develop programs using functions.
- Write C programs for simple applications.

21UME109	ENGINEERING GRAPHICS (Common to ALL Branches-Except CSBS, CSD and AI&DS))	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
- To impart knowledge in development of surfaces, isometric and perspective projections.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)	**4**

Importance of Graphics in Engineering Applications – Use of Drafting Instruments – BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning - Introduction to Plane Curves, Projection of Points, Lines and Plane Surfaces

Unit I	**PROJECTION OF SOLIDS**	**12**

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.

Unit II	**SECTION OF SOLIDS**	**10**

Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one of the plane.

Unit III	**DEVELOPMENT OF SURFACES**	**10**

Development of lateral surfaces of simple and truncated solids - Prisms, pyramids and cylinders and cones - Development of lateral surfaces of sectioned solids.

Unit IV	**ISOMETRIC PROJECTIONS**	**12**

Principles of isometric projection – isometric scale – isometric view - isometric projections of simple solids and cut solids.

Unit V	**ORTHOGRAPHIC PROJECTION**	**12**

Representation of Three Dimensional objects – General principles of orthographic projection- Need for importance of multiple views and their placement – First angle projection – layout views – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects

TOTAL 45 (L) + 15 (T) = 60 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings.	Understand
CO.2	Apply the principles of orthographic projections to draw projections of solids and sections of solids	Apply
CO.3	Develop lateral surfaces of regular and sectioned solids.	Apply
CO.4	Prepare isometric drawings of simple solids from orthographic views.	Apply
CO.5	Construct orthographic projection from the given pictorial view.	Apply
CO.6	Analyze the projections of various solid models using different resting conditions.	Analyze

Text Books:

1. Natarajan K.V., “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, (2006).
2. Bhatt N.D., “Engineering Drawing”, 46th Edition, Charotar Publishing House, (2003).

Reference Books:

1. Venugopal K., and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, (2008).
2. Gopalakrishnan K.R., “Engineering Drawing” (Vol.I&II), Subhas Publications. (1998).
3. DhananjayA.Jolhe, “Engineering Drawing with an introduction to Auto CAD”.
4. Tata McGraw Hill Publishing Company Limited, (2008).

21UME109	PROBLEM SOLVING AND C PROGRAMMING LABORATORY (Common to ALL Branches-Except CSBS)	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To make the students to work with office software.
- To familiarize the implementation of programs in C.

LIST OF EXPERIMENTS:

A) WORD PROCESSING

Document creation. Formatting, Table Creation, Mail merge

B) SPREAD SHEET

Chart – Line XY, Bar and Pie, Formula – Formula editor

C) C PROGRAMMING

- Programs using simple statements.
- Programs using decision making statements.
- Programs using looping statements.
- Programs using one dimensional and two dimensional arrays.
- Solving problems using string functions.
- Programs using user defined functions and recursive functions.
- Programs using pointers.
- Programs using structures and unions.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

- After the successful complementation of this course, the student will be able to
- Create the document in Word Processing Software.
- Write programs using control constructs.
- Apply functions to reduce redundancy.
- Design and implement C programs for simple applications.

HARDWARE/SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

21UME111	ENGINEERING PRACTICES LABORATORY (Common to Mech, EEE, Civil, Agri and Chemical)	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To demonstrate the plumbing and carpentry works.
- To train the students to perform welding, fitting and drilling operations.
- To demonstrate residential house wiring, fluorescent lamp wiring, measurement of earth resistance, Color coding of resistors, logic gates and soldering.

GROUP A (CIVIL & MECHANICAL)
CIVIL ENGINEERING PRACTICE

LIST OF EXPERIMENTS

1. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.
2. Preparation of plumbing line sketches for water supply and sewage works.
3. Hands-on-exercise: Basic pipe connections–Mixed pipe material connection Pipe connections with different joining components.
4. Demonstration of plumbing requirements of high-rise buildings.
5. Study of the joints in roofs, doors, windows and furniture.
6. Hands-on-exercise: Wood work, cutting, planning and joints by sawing –Half lap joint

MECHANICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

1. Preparation of arc welding of butt joints, lap joints and tee joints.
2. Drilling Practice.
3. Sheet metal model making – Trays, funnels, etc.
4. Different type of fittings-'V' type, 'L' Type
5. Study of Lathe Machine tool.
6. Study of Plastic Injection Moulding.

GROUP B (ELECTRICAL & ELECTRONICS)
ELECTRICAL ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

a) Residential house wiring using switches, fuse, indicator, lamp and energy meter and Stair case wiring.

b) Fluorescent lamp wiring.

c) Measurement of resistance to earth of electrical equipment.

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ELECTRONICS ENGINEERING PRACTICE

LIST OF EXPERIMENTS:

a) Study of Electronic components and equipments – Resistor, colour coding

b) Measurement of AC Signal parameter (peak-peak, rms, period, frequency) using CRO.

c) Study of logic gates AND, OR, EX-OR and NOT Gate.

d) Soldering practice – Components, Devices and Circuits – Using general purpose

e) PCB.

TOTAL: 30 Period

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

COs	CO Statements	BT Levels
CO.1	Illustrate the centrifugal pump, air conditioner, lathe machine tool, molding, operations of foundry and fittings.	Understand
CO.2	Demonstrate the carpentry work and plumping work for a given diagram to complete the work.	Apply
CO.3	Select suitable tools for fabrication of sheet metals like cone, funnel and tray.	Apply
CO.4	Practice the welding and drilling operations for the various structures.	Apply
CO.5	Manipulate the components, Logic gates, soldering practices with help of printed circuit boards (PCB).	Apply
CO.6	Operate the various electronic components and using that for the industrial and housing application.	Apply

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EQUIPMENT REQUIREMENT

CIVIL ENGINEERING

S. No.	Name of the equipment	Quantity Required
1	Assorted components for plumbing consisting of metallic Pipes, plastic pipes, flexible pipes, couplings, unions, Elbows, plugs and other fittings	5 sets
2	Carpentry vice (fitted to workbench)	15 Nos
3	Standard working tools	15 sets
4	Models of industrial trusses, door joints, furniture joints	5 each
5	Power tool rotary hammer	2 Nos
6	Demolition hammers	2 Nos
7	Planer	2 Nos
8	Hand drilling machine	2 Nos
9	Jigsaw	2 Nos

MECHANICAL ENGINEERING

S. No.	Name of the equipment	Quantity Required
1.	Arc welding transformer with cables and holders	5 Nos
2.	Welding booth with exhaust facility	5Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit	2 `Nos
5.	Vice	5 Nos
6.	Hacksaw frame and blade	5 Nos
7.	Files	5 Nos
8.	Study-purpose items: Centre Lathe, pattern, cope & drag box and moulding tools	Each 1 No.

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ELECTRICAL ENGINEERING

S. No.	Name of the equipment	Quantity Required
1.	Assorted electrical componentsforhouse wiring	15 sets
2.	Electrical measuring instruments	10sets
3.	Megger (250V/500V)	1 No
4.	Study purpose items: Iron box, fanand regulator, emergency lamp	One each
5.	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 No 2 No

ELECTRONICS ENGINEERING

S. No.	Name of the equipment	Quantity Required
1.	Logic trainer kit	2 No
2.	CRO,AFO	2 Each
3.	Small multipurpose PCBs	10 No
4.	Soldering guns	10 No
5.	Multimeters	5 No
6.	Assorted electronic components for making circuits	Required quantity

21UGS113	BASIC SCIENCES LABORATORY I (Common to All Branches-Except CSBS)	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival of conclusions.
- To view and realize the theoretical knowledge acquired by the students through experiments.

LIST OF EXPERIMENTS
(Common to All Branches)

1. Laser – Determination of particle size and wavelength of Laser source. using Diode Laser.
2. Ultrasonic Interferometer - Determination of velocity of sound and compressibility of liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid.
4. Spectrometer – Determination of dispersive power of a prism.
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method – Determination of Young's modulus of the given rectangular beam.

A minimum of FIVE experiments shall be offered

TOTAL - 30 Periods

CHEMISTRY LABORATORY

Course Learning Objectives:

- To impart knowledge on basic concepts in applications of chemical analysis.
- Train the students to handle various instruments.
- To acquire knowledge on the chemical analysis of various metal ions

LIST OF EXPERIMENTS

(Common to All Branches-Except CSBS)

1. Preparation of molar and normal solutions of the following substances – Oxalic acid , Sodium Carbonate , Sodium Hydroxide and Hydrochloric acid.
2. Conductmetric Titration of strong acid with strong base 3.Conductometric Titration of Mixture of Acids.
3. Estimation of Iron by potentiometry.
4. Determination of Strength of given acid using pH metry.
5. Determination of molecular weight of polymer by viscometry.
6. Comparison of the electrical conductivity of two samples-conductometric method.
7. Estimation of copper in brass by EDTA method.

A minimum of FIVE experiments shall be offered for every course

TOTAL: 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the principles of Optics, Laser physics and Mechanics to determine the Engineering properties of materials.	Apply
CO.2	Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents.	Apply
CO.3	Apply the principles of spectroscopy to determine the properties using prism.	Apply
CO.4	Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis	Apply
CO.5	Analyze the concentration of a given analyte by analytical methods.	Analyze
CO.6	Analyze the given liquid sample to determine the viscosity and compressibility of the liquid.	Analyze

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II SEMESTER

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21UEN201	COMMUNICATION SKILLS FOR PROFESSIONALS (Integrated course) (Common to All Branches-Except CSBS)	L	T	P	C
		1	0	1	1.5

Course Learning Objectives:

- Improve their oral expression and thought.
- Develop their confidence and ability to speak in public.
- Develop their capacity for leadership.

Unit I	SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE	(Time: 5 to 7 minutes)

To Speak in front of an audience with courage.

• Make your message clear, with supporting material.

• Create a strong opening and conclusion.

Unit II	SPEAK ON THE CHOSEN CONTENT	(Time: 5 to 7 minutes)

Select a general topic and bring out specific purposes.

• Avoid using notes.

• Use symbolic ideas to develop your ideas

Unit III	USE EFFECTIVE BODY LANGUAGE & INTONATION	(Time: 5 to 7 minutes)

• Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.

• Use proper intonation and adequate speech module.

Unit IV	PRESENT YOUR TOPIC WITH VISUAL AIDS	(Time: 5 to 7 minutes)

• Persuade your points with suitable illustration, specific facts, examples.

• Use suitable visual aids to present your topic with confidence.

Unit V	GRASP THE ATTENTION OF THE AUDIENCE	(Time: 5 to 7 minutes)

• Influence your listeners by adopting holistic viewpoint.

• Use emotions, stories, and positive quotes in your speech.

Total Hours =30 periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Communicate information ideas and opinions in any given situations.	Apply
CO.2	Use language appropriately with clarity and fluency in any given circumstances.	Apply
CO.3	Appraising the audience with clarity of thoughts with leadership quality.	Apply
CO.4	Present the ideas creatively with coherence for given topic.	Apply
CO.5	Evaluate the use of language to provide suggestions for correct usage.	Apply

Reference Books:

1. Competent Communication- A Practical Guide to becoming a better speaker, Toastmasters International, USA.
2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

21UMA206	DIFFERENTIAL EQUATIONS, COMPLEX ANALYSIS AND TRANSFORM TECHNIQUES (Only for Civil)	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.
- To make the student acquire sound knowledge of Laplace transform and its properties and sufficient exposure to the solution of certain linear differential equations using the Laplace transform technique.

Unit I	SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS	8+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE (Bacterial growth, Population growth, Decayed problems).

Unit II	VECTOR CALCULUS	8+3

Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields –Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopiped.

Unit III	PARTIAL DIFFERENTIAL EQUATIONS	8+3

Formation of partial differential equations – Singular integrals -- Solutions of standard types of first order partial differential equations – Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types

Unit IV	COMPLEX INTEGRATION	9+3

Statement and applications of Cauchy's integral theorem, Cauchy's integral formula and Cauchy Residue Theorem – Taylor's and Laurent's expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).

Unit V	LAPLACE TRANSFORM	9+3

Existence conditions – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function, impulse function and periodic function - Inverse Laplace transform – Convolution theorem (excluding Proof) –Solution of linear ODE of second order with constant coefficients.

SUPPLEMENT TOPIC (for internal evaluation only)	3

Evocation / Application of Mathematics.

TOTAL : 45 (L) + 15 (T) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the knowledge of higher order ordinary differential equations in real life engineering problems.	Apply
CO.2	Apply the concept of vector identities in problem solving and evaluate the line, surface and volume integrals.	Apply
CO.3	Apply the knowledge of partial differential equation in solving linear and higher order partial differential equation.	Apply
CO.4	Apply the knowledge of singularities, residues in complex integration.	Apply
CO.5	Apply the knowledge of Laplace transform and solve the problems with periodic function, inverse transform of convoluted function and Ordinary Differential Equation.	Apply
CO.6	Apply the concept of particular integral, scalar potential, poles and periodic function.	Apply

Text Books:

1. VEERARAJAN.T “Engineering Mathematics” Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. BALI N. P and MANISH GOYAL, “Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, (2008).
3. GREWAL. B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 43rd Edition, (2014).

Reference Books:

1. RAMANA B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. KREYSZIG. E, “Advanced Engineering Mathematics”, John Wiley & Sons, New York, 10th Edition, (2011).
3. JAIN R.K and IYENGAR S.R.K, “Advanced Engineering Mathematics”, Narosa Publishing House Pvt. Ltd., New Delhi, 3rd Edition, (2007).
4. GLYN JAMES, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 3rd Edition, (2007).

21UPH206	BUILDING PHYSICS (Only for Civil)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To examine how sound is generated and propagates as a principle for architectural acoustic design.
- To develop the fundamental research interest in Nano materials.
- To explore the detailed behavior of new engineering materials.

Unit I	THERMAL INSULATION OF BUILDINGS	13

Introduction-Thermal conduction, convection and Radiation- Thermal insulation-principles-Heat insulating materials- methods of heat insulation - heat gain and heat loss estimation - factors affecting the thermal performance of buildings -shading devices - central heating- Benefits of thermal insulation

Unit II	BUILDING ACOUSTICS	10

Introduction- Reverberation Time– Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination —Factors affecting acoustics of buildings and their remedies –Echoes - Resonance-Noise – Loudness - Factors to be followed for good acoustics of building-Noise control in buildings

Unit III	NEW ENGINEERING MATERIALS	12

Introduction-Metallic glasses– preparation – properties - applications -Shape memory alloys– preparation – properties & applications – Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Unit IV	COMPOSITESAND CERAMIC MATERIALS	10

Composites – definition and classification – Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) :Ceramic Materials: Introduction - Classification – Methods of Processing – Slip casting - Isostatic pressing - Gas pressure bonding -Properties – Application.

UNIT V NANOMATERIALS

Introduction tonanomaterials-one, two, three dimensional nanomaterials, quantum dots –Bucky ball- carbonnanotubes – graphene, Synthesis-Top down approach-Ball milling, Bottom approach –Physical vapour deposition, Chemical vapour deposition, solgel method,Properties; Mechanical, optical, thermal and electrical properties scanning electron microscope Application of nanomaterias

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the fundamental concepts of physics which provides foundation for building construction design.	Understand
CO.2	Apply the concept of physics for thermal and sound insulation in building design.	Apply
CO.3	Illustrate new engineering materials and their properties, encountered in civil engineering.	Apply
CO.4	Apply the science of architectural acoustics in building design.	Apply
CO.5	Analyze the effect of new engineering materials, composites and nanomaterials to improve strengthening of building materials.	Analyze
CO.6	Analyze the thermal concepts of buildings to design various building models with reference to climatic changes of environment.	Analyze

Text Books:

1. William D. Callister, Jr. “Material Science and Engineering”, Seventh Edition,
2. John Wiley & Sons Inc.New Delhi, 2018.
3. Dr. Mani.P, “ Building Physics ”, Dhanam Publications, Chennai Revised Edition, 2018.
4. M. N. Avadhanulu and P. G. Kshirsagar,A “Textbook of Engineering Physics”, S. Chand & Company Ltd., New Delhi, 2015.

Reference Books:

1. V. Rajendran, Engineering Physics, Tata McGraw-Hill, New Delhi, 2017.
2. P. K. Palanisami, “Physics for Engineers’, Vol. 1, Scitech Pub. (India) Pvt. Ltd., Chennai, 2012.
3. R. K. Gaur and S. L. Gupta,” Engineering Physics”, DhanpatRai Publishers, New Delhi, 2016.

21UCE204	ENGINEERING MECHANICS (Only for Civil)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge on equilibrium of particles and rigid bodies both in two and three dimensions.
- To help the students to calculate centroid and moment of inertia of areas and sections.
- To comprehend the effect of friction on equilibrium.

Unit I	STATICS OF PARTICLES	9

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles - Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

Unit II	EQUILIBRIUM OF RIGID BODIES	9

Types of supports – Action and reaction forces –stable equilibrium – Principle of Transmissibility- Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two and three dimensions.

Unit III	PROPERTIES OF SURFACES AND SOLIDS	9

Definition of Centroid & Centre of Gravity - Axes of Symmetry - Centroid of basic shapes by Integration - Numerical problems on Centroid of Composite sections - Theorems of Pappus & Guldinus - Concept of Moment of inertia - perpendicular axis theorem - parallel axis theorem - Moment of inertia of basic shapes by Integration - Numerical problems on moment of inertia of composite sections - Mass Moment of Inertia.

Unit IV	FRICTION	9

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – Ladder friction - Rolling resistance.

Unit V	DYNAMICS OF PARTICLES	9

Displacements, Velocity and acceleration, their relationship – Relative motion – Rectilinear motion - Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the fundamental concepts of engineering mechanics.	Understand
CO.2	Apply laws of statics and dynamics to resolve the unknown forces of particles and rigid bodies under equilibrium.	Apply
CO.3	Apply laws of mechanics to compute the properties of surfaces and solids.	Apply
CO.4	Analyze the equilibrium of particles and rigid bodies in 2D and 3D, to resolve the unknown forces.	Analyze
CO.5	Analyse the simple and compound stresses induced in rigid bodies subjected to various loadings.	Analyze
CO.6	Evaluate the Rigid bodies for various loading conditions.	Evaluate

Text Books:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 10th Edition, Tata McGraw-Hill Publishing company, New Delhi (2010).
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.
3. Bhavikatti, S.S., "Engineering Mechanics", 7th Edition, New Age International (P) Limited Publishers (2017).

Reference Books:

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 14th Edition, Pearson Education (2015).
2. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", 7th Edition, John Wiley & Sons (2013).
3. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd. (2005).
4. Dr.N.Kottiswaran, "Engineering Mechanics – Statics & Dynamics" Sri Balaji Publications, 2013.

21UEE226	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (Common to Civil and Mechanical)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- This course facilitates the students to get a comprehensive exposure to electrical and electronics engineering.

Unit I	DCAND AC CIRCUITS	9

Direct currents and voltages, power, Kirchoffs Laws, Alternating current and voltage, Peak, RMS and average values, circuit elements R,L &C, Phasor Diagram, impedance, real and reactive power in single phase circuits.

Unit II	DC MACHINES AND TRANSFORMERS	9

DC machines Construction, principle of operation and applications, Single phase transformer – construction, principle of operation, Introduction to three phase systems.

Unit III	AC MACHINES	9

Synchronous and Induction machines -Construction, Principle of operation, and applications.

Unit IV	SPECIAL MACHINES	9

Brushless D.C Motor, Stepper Motor, Linear motor and Universal Motor – Construction, Principle of operation and applications.

Unit V	INTRODUCTION TO ELECTRONICS	9

Diode- PN Diode, Zener Diode, BJT Configurations, Rectifiers, Data acquisition system- ADC, DAC – principles of operation

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Summarize the working principle and construction of DC machines and transformers.	Apply
CO.2	Apply the basic laws of electrical circuits to linear circuit problems.	Apply
CO.3	Design the principle of operation and construction of AC machines.	Apply
CO.4	Design the working principle and construction of Special machines.	Apply
CO.5	Illustrate the characteristics of basic semiconductor devices.	Apply

Reference Books:

1. V K Mehta and Rohit Mehta,"Principles of Electrical Engineering and Electronics", S. Chand Publishing, New Delhi, 2019.

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2.	Arumugam M. and Premkumar N., “Electriccircuits theory”, Khanna Publihsers, 7thedition, NewDelhi,2007.
3.	Kothari D.P. Nagrath I.J, “Electric Machines”, Tata McGraw Hill, 2009.
4.	K. Venkataratnam, Special Electrical Machines, Universities Press, 2014.
5.	R.J.Smith, R.C.Dorf, Circuits devices and systems, 5th edition, John Wiley and sons2001.
6.	Malvino, A.P, Leach D.P and GowthamSha, Digital Principles and Applications, 6th Edition, Tata McGraw hill, 2007.

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21UGS210	BASIC SCIENCES LABORATORY II (COMMON TO ALL BRANCHES-Except CSBS)	L	T	P	C
		0	0	2	1

Course Learning Objectives:

- To analyze the Band gap, moment of inertia, thermal conductivity and rigidity modulus of the materials.
- To gain knowledge in PHOTONICS.

PHYSICS LABORATORY

LIST OF EXPERIMENTS

1.Determination of Energy band gap of a semiconductor.

2.Torsion pendulum – Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.

3. Spectrometer - Determination of wavelength of mercury spectrum using grating.

4. Laser – Determination of numerical aperture and acceptance angle of an optical fiber.

5. Newton's rings – Determination of radius of curvature of a convex lens.

6. Lee's Disc - Determination of thermal conductivity of a bad conductor.

7. Determination of Solar cell Characteristics using optical transducers kit.

A minimum of FIVE experiments shall be offered

CHEMISTRY LABORATORY
LIST OF EXPERIMENTS

1.Estimation of hardness of water by EDTA method.

2.Estimation of alkalinity of water sample.

3.Estimation of Chloride in water sample (Argentometric method).

4.Determination of DO in water.

5.Estimation of chromium in tannery wastes.

6.Estimation of available chlorine in bleaching powder.

7.Estimation of iron by Spectrophotometry.

8.Determination of acidity of industrial effluents.

A minimum of FIVE experiments shall be offered **TOTAL: 45 Periods**

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the principles of Light and Elasticity to determine the Engineering properties of materials.	Apply
CO.2	Apply the basic knowledge of water quality testing for environmental sustainability.	Apply
CO.3	Estimate the quality of water that suits for domestic and industrial applications.	Apply
CO.4	Analyze the thermal conductivities of different bad conductors.	Analyze
CO.5	Analyze the Characteristics of a semiconductor.	Analyze
CO.6	Analyze the water quality parameters for industrial effluents to prevent water pollution.	Analyze

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21UCE211	COMPUTER AIDED BUILDING DRAWING (only for Civil)	L	T	P	C
		0	0	3	1.5

Course Learning Objectives:

- To prepare the Plan, Elevation and Sectional views of buildings in accordance with Development and Control rules satisfying orientation and functional requirements as per National Building Code.

PART – A

Manual Drawing:

Principles of Planning, Orientation–Cross section of a load bearing wall (including door, steps, floor, lintel & sunshade, roof, parapet, weathering course, etc.)

PART - B

Drawing using Drafting software:

Basic AutoCAD Commands [The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects; Isometric Views of lines, Planes, Simple and compound Solids]- simple diagrams using the Commands

.**Preparation of Plan, Elevation and Section of**

1. Single Storey Residential Building – (Plan, Elevation & Section
2. Double Storied Residential Building with staircase using given area- RCC framed structure (Plan, Elevation & Section)
3. Library building plan
4. Fully tiled gable house
5. Institutional building - School (Plan,)

3D view of a single story residential building. **TOTAL: 45 Periods**

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Prepare a Plan, Front Elevation and Sectional Elevation and Section Elevation from line diagram and develop submission drawings for building.	Apply
CO.2	Prepare a plan, Elevation and Section of R.C.C framed buildings with typical cross sections of footings, beams and columns.	Apply
CO.3	Interpret the basic concept and usage of CADD software. Compare the utilities of alternate drafting software from open source.	Apply
CO.4	Plan and Design a residential, Public buildings as per requirements.	Apply
CO.5	Prepare a plan, Front Elevation and Sectional Elevation and Sectional Elevation from line diagram and develop submission drawings for building.	Apply

TextBooks:

GeorgeOmura.,—MasteringinAutocad2019‖,WileyPublishers,(2019).

ShamTickooSwapnaD.,—AdvancedAUTOCAD2018‖,BPBPublicationsLtd,(2018).

Rangwala.,—CivilEngineeringDrawing‖,CharotarPublishinghousePvt.Ltd,(2017).

Verma.B.P.,—CivilEngineeringDrawingandHousePlanning‖,KhannaPublishers,(2014).

SikkaV.B.,—ACourseinCivilEngineeringDrawing‖,S.K.KatariaandSons,(2015-4thEdition).

Reference Books:

Rangwala.,—CivilEngineeringDrawing‖,CharotarPublishingHousePvt.Ltd,(2017).

—AGuidetobuildinginformationmodelingforOwners,Managers,Designers,Engineers,andContractors‖,JohnWiley andSons.Inc.,(2018).

Balagopal&T.S. Prabhu.,—Buildingdrawing &detailing–,SpadesPublishers‖,Calicut.

DavidS.Cohn.,–AutoCAD2000‖,TataMcGraw Hill,PublishingCompany, NewDelhi,(2000).

5. Marimuthu V.M., Murugesan R. and Padmini S., —Civil Engineering Drawing-I‖, PratheebaPublishers,(2008).

III SEMESTER

21UMA325	PROBABILITY, STATISTICS AND TRANSFORM TECHNIQUES (only for Civil)	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To make the student acquire sound knowledge of standard distributions that can describe real life phenomena.
- To acquaint the student with Fourier transform techniques used in variety of situations.
- To acquaint the student with the basics of Z - transform in its applicability to discretely varying functions, gained the skill 423to formulate certain problems in terms of difference equations and solve them using the Z - transform technique bringing out the elegance of the procedure involved

Unit I	RANDOM VARIABLES	9+3

Axioms of probability - Conditional probability - Total probability - Bayes' theorem – Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Normal, Geometric, Uniform, Exponential and Gamma distributions**.**

Unit II	TESTING OF HYPOTHESIS	9+3

Sampling distributions - Normal, t, Chi-square and F distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

Unit III	FOURIER SERIES	9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Perceval's identity – Harmonic analysis - Application of Fourier series

Unit IV	FOURIER TRANSFORM	9+3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Perceval's identity - Application of Fourier Transform.

Unit V	Z-TRANSFORM AND DIFFERENCE EQUATIONS	9+3

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value Theorems - Formation of difference equations – Solution of difference equations.

TOTAL : 45 (L) + 15 (T) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions.	Apply
CO.2	Apply the concept of testing of hypothesis for small and large samples in Real life Problems.	Apply
CO.3	Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems.	Apply
CO.4	Apply the Fourier Transform techniques to evaluate the given integral problems using Fourier Cosine transform, Sine Transform and its properties.	Apply
CO.5	Apply the acquired knowledge of Z transform and its properties inverse Z transform and difference equations.	Apply
CO.6	Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions.	Apply

Text Books:

1. GUPTA S.C., KAPOOR V.K. “Fundamental of Mathematical Statistics” 10th Edition, Sultan Chand and Sons, New Delhi, 2002.
2. GREWAL, B.S., “Higher Engineering Mathematics,” Khanna Publishers, New Delhi, 35th Edition, (2010).
3. JOHNSON R.A. and GUPTA C.B., “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, New Delhi, 8th edition, (2011).

Reference Books:

1. WALPOLE. R.E., MYERS .R.H., MYERS S.L., and YE. K, “Probability and Statistics for Engineers and Scientists”, Pearson Education, New Delhi, 8th edition, (2007).
2. SPIEGEL M.R., SCHILLER J. and SRINIVASAN R.A., “Schaum’s Outlines Probability and Statistics”, Tata McGraw Hill, New Delhi, (2004).
3. GLYN JAMES, “Advanced Modern Engineering Mathematics”, Pearson Education, New Delhi, 3rd Edition, (2007).
4. ERWIN KREYSZIG, “Advanced Engineering Mathematics”, Wiley India, 10th Edition, (2011).

21UCE302	ENGINEERING GEOLOGY AND CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To familiarize with surface and subsurface investigations to study about rocks and minerals.
- To impart knowledge on properties of various construction materials and their practices.
- To understand the concept of advanced material usage in construction field

Unit I	MINERALS AND ROCKS	9

Geology in civil engineering – Branches of geology - Minerals, their physical properties – rock forming minerals, Formation of rocks – types of rocks - physical and engineering properties of igneous, metaphoric, and sedimentary rocks.

Unit II	INTERIOR AND STRUCTURES OF EARTH	9

Earth's interior based on seismic models, plate tectonics and continental drift, study of earth's structures – geological maps – attitude of beds - fold, faults and joints, geological factors affecting Civil Engineering constructions, and their uses.

Unit III	CONSTRUCTION MATERIALS AND PROPERTIES	9

Stone as building material – Criteria for selection – Tests on stones – Bricks – Classification Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption - Efflorescence – Bricks for special use – Refractory bricks- Brick and Stone – Properties, Uses and Tests - Concrete Blocks – Fly ash Blocks - Hollow Block - Lightweight Block and Paver Blocks.

Unit IV	BINDING MATERIALS AND AGGREGATES	9

Lime – Preparation of lime mortar -Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance –Fine aggregate - Grading – Sand Bulking.

Unit V	MISCELLANEOUS AND MODERN MATERIALS USED IN CONSTRUCTION	9

Timber Classification, properties - defects in timber - Processing, seasoning and preservation. Alternate and Composite materials -Veneering, Plywood, Particle board, Gypsum board, PVC doors and windows. Steel and aluminium- properties and uses of different types of steel - Market forms of steel - Anticorrosive treatment for steel - Properties of Asbestos, Paints, Varnishes and Distempers – Applications of Thermocol - Bitumen's - Glass –Fibre glass reinforced plastic – Clay products – Fibre textiles– Geomembranes and Geotextiles for earth reinforcement.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the characteristics of minerals, rocks and materials, interior structure of the earth based on the functional requirements.	Understand
CO.2	Examine the construction material properties, sources and suitability tests in practice.	Apply
CO.3	Categorize the minerals, rock types & construction materials based on their application in construction.	Apply
CO.4	Analyse the cost and uses of construction materials available in market.	Apply
CO.5	Appraise the quality of construction materials and binders in the laboratory and on the field.	Apply
CO.6	Evaluate the project site conditions considering the various geological structures.	Evaluate

Text Books:

1. Parbin Singh. A Text book of Engineering and General Geology, S.K.Kataria& Sons, Katson educational series, 2013.
2. Varghese.P.C, Building Materials, second edition of Prentice Hall India Learning Pvt.Ltd, (2015)

Reference Books:

1. Varghese, P.C., Engineering Geology for Civil Engineering PHI Learning Private Limited, New Delhi, (2012).
2. S.K.Duggalet al. Engineering Geology, McGraw Hill Education Pvt. Ltd. (2017).
3. Rangwala, Engineering Materials, Charotar Publishing House Pvt. Ltd. (2017).
4. Rajput.R.K., Engineering Materials, S. Chand and Company Ltd., (2008).

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21UCE303 STRENGTH O	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To learn the fundamental concepts of Stress in simple and complex states.
- To provide knowledge on shear force and bending moment for all beams by recognizing the beam type and loading thereby calculating slope and deflectionusing various methods.
- To have knowledge on determining the behavior of columns and cylinders.
- To develop knowledge on unsymmetrical bending of beams to locate shear center and various failure theories.

Unit I	**SIMPLE AND COMPOUND STRESSES**	**9+3**

Stresses in simple and compound bars – Thermal stresses – Elastic constants - Thin cylindricaland spherical shells – Biaxial state of stress – Principal stresses and principal planes – Mohr's circle of stresses - Torsion on circular shafts.

Unit II	**BENDING AND DEFLECTION OF BEAMS**	**9+3**

Types of beams and transverse loadings– Shear force and bending moment for Simply supported, cantilever and over-hanging beams - Theory of simple bending – Stress distribution – Deflection of Beams - Double Integration method – Macaulay's method – Area moment method – Conjugate beam method

Unit III	**INDETERMINATE BEAMS**	**9+3**

Propped Cantilever and Fixed Beams – Fixed end moments reactions, slope and deflection for standard cases of loading –– Continuous beams – support reactions and moments – Theorem of three moments – Shear Force and Bending Moment Diagrams.

Unit IV	**COLUMNS AND CYLINDERS**	**9+3**

Euler's theory of long columns – critical loads for prismatic columns with different end conditions;
Rankine's-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core section – Stresses in thin cylindrical and spherical shell – thick cylinder.

Unit V	**ADVANCED TOPICS**	**9+3**

Unsymmetrical bending of beams - shear Centre - Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories – application problems – Curved beams – Winkler Bach Formula - Stresses in Hooks.

TOTAL : 45 (L) + 15 (T) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the concepts and principles of bending theory, column theory and failure theories.	Understand
CO.2	Apply the various methods to compute shear force, bending moment and deflection of determinate and indeterminate beams.	Apply
CO.3	Determine load carrying capacity and stresses induced in columns, cylinders, spherical shells and hooks.	Apply
CO.4	Analyze support conditions and loading conditions using structural elements.	Analyze
CO.5	Evaluate the reinforcement and deflection distribution as per SFD & BMD using codal provisions.	Evaluate
CO.6	Apply the stress strain distribution of structural elements.	Apply

Text Books:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & Company Ltd., New Delhi, 2015.
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials, Laxmi publications. New Delhi, 2015.
3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain,"Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017.
4. Rattan . S. S, “Strength of Materials”, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
5. Bansal. R.K. “Strength of Materials”, Laxmi Publications Pvt. Ltd., New Delhi, 2010.

Reference Books:

1. Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House, New Delhi 2016.
2. Singh. D.K., “ Strength of Materials”, Ane Books Pvt. Ltd., New Delhi, 2016.
3. Basavarajaiah, B.S. and Mahadevappa, P., Strength of Materials, Universities Press, Hyderabad, 2016.
4. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.

21UCE304	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand and explain the concept of water treatment process and components of water supply system.
- To have adequate knowledge on distribution network and water supply to buildings.
- To equip the students with the principles and design of water treatment and distribution.

Unit I	INTRODUCTION TO WATER SUPPLY SYSTEM	9

Public water supply system – Planning, Objectives, Design period, Population forecasting (Arithmetic Increase method, Geometric Increase method, Incremental Increase method & Decreasing rate method); Water demand – Sources of water and their characteristics –Surface and Groundwater – Impounding Reservoir – Development and selection of source – Water quality – Characterization – Significance – Drinking Water quality standards.

Unit II	COLLECTION AND CONVEYANCE OF WATER	9

Water supply – Intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pump – Selection of pumps and pipe materials.

Unit III	CONVENTIONAL WATER TREATMENT	9

Objectives – Unit operations and processes – Principles, functions, design, Operation & Maintenance aspects of water treatment plant, aerators, flash mixers, Coagulation, flocculation sedimentation tanks and sand filters – Design of Chemical feeding devices and Clariflocculator - Plate and tube settlers - Pulsator clarifier - Disinfection - Residue Management.

Unit IV	ADVANCED WATER TREATMENT	9

Water softening – Iron and Manganese removal - Defluoridation - Adsorption – Desalination - R.O.Plant – demineralization process – Ion exchange – Membrane Systems – Operation & Maintenance aspects – Recent Advances - Sky Water Technology – Biofiltration – Ultraviolet Germicidal Irradiation.

Unit V	WATER DISTRIBUTION AND SUPPLY TO BUILDINGS	9

Requirements of water distribution – Components – Service reservoirs Functions – Network design – Analysis of distribution networks – Software's used in Distribution process (EPANET, QANET) - Leak detection methods – Water supply to buildings - House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Define, Understand and explain the concept of water treatment process and components of water supply system.	Understand
CO.2	Apply the knowledge of water supply and treatment principles to be able to design the treatment process, supply mains, distribution network by calculating the water demand.	Apply
CO.3	Analyze the water quality and treatment, pump and pipe materials for the distribution system.	Analyze
CO.4	Design solution for water treatment and network system components that meet the specified needs with appropriate consideration for the public health and environmental consideration.	Apply
CO.5	Use the knowledge based on Analysis and Interpretation of population and water quality data to provide valid conclusion for treatment processes and network design.	Evaluate
CO.6	Select and apply appropriate advanced techniques for treatment and modern tools like EPANET, QANET for water distribution system.	Apply

Text Books:

1. Garg, S.K. Environmental Engineering, Vol.I& II Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.

Reference Books:

1. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2010.
2. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
3. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.
4. Introdution to Environmental Engineering by P.AarneVesilind, Susan M. Morgan, Thompson/ Brooks/Cole; Second edition 2008.

21UCE305	FLUID MECHANICS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the students about properties of the fluids, behaviour of fluids under static Conditions.
- To impart basic knowledge of the dynamics of fluids through flow measurements, flow through pipes (both laminar and turbulent) and forces on pipe bends with an exposure to the significance of boundary layer theory and its applications.
- To study the fundamentals of dimensional analysis and model studies.

Unit I	FLUIDS PROPERTIES AND STATICS	9

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and sensors - forces on planes – Centre of pressure – buoyancy floatation.

Unit II	FLUID KINEMATICS AND DYNAMICS	9

Fluid Kinematics – Classification and types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net. Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications – Venturimeter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.

Unit III	DIMENSIONAL ANALYSIS & MODEL STUDIES	9

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - dimensionless parameters - similitude and model studies - distorted models

Unit IV	FLOW THROUGH PIPES	9

Reynold's experiment - laminar flow through circular pipe (Hagen poiseulle's) – flow through pipes - Darcy - Weisbach's equation - pipe roughness -friction factor - Moody's diagram- major and minor losses of flow in pipes - hydraulic and energy gradient line - pipes in series and in parallel.

Unit V	BOUNDARY LAYER	9

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer - displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation and control – drag on flat plate.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the basic concepts of fluid statics, dynamics, model studies and boundary layer.	Understand
CO.2	Apply the concept of statics and dynamics to solve the fluid flow problems.(Apply)	Apply
CO.3	Analyse the fluid flow problems with momentum and energy equations.	Analyse
CO.4	Evaluate the critical properties of fluids under different scenarios to suit field conditions.	Evaluate
CO.5	Investigate the fluid flow problems and models using the knowledge of statics& dynamics.	Evaluate
CO.6	Create a model of any measurement device using modern engineering and IT Tools to predict the fluidpressure.	Apply

Text Books:

1. Bansal R.K. Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2018.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 2002.

Reference Books:

1. Jain. A.K., Fluid Mechanics, Khanna Publishers, Delhi, 2010
2. Kumar K.L., “Engineering Fluid Mechanics” Eurasia Publishing House, 2016
3. Rajput R.K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, Ninth Edition 2016.

21UCE306	SURVEYING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the basics concepts of surveying using Convention Surveying Techniques.
- To find the angular measurements and difference in elevations using Theodolite and Tachometric Surveying.
- To introduce the basic concepts of different Modern Survey Techniques.

Unit I	FUNDAMENTALS OF SURVEYING AND LEVELLING	9

Basic principles of surveying- Classification- Chain Surveying - Equipment and accessories for ranging and chaining - Principles of Compass Surveying - Bearing and Types - local attraction and its elimination- Plane table surveying - Principles and theory of Leveling – Methods – Booking and Reduction - Curvature and refraction correction - Contouring.

Unit II	THEODOLITE AND TACHEOMETRIC SURVEYING	9

Theodolite surveying: Components, Horizontal and vertical angle measurements - Temporary and permanent adjustments – Tacheometric Surveying – Tangential and Stadia systems - Stadia constants - Anallatic lens – Subtense bar - Computation of cross sectional areas and volumes – LS and CS - Earthwork calculations - Mass haul diagrams.

Unit III	CONTROL SURVEYING AND CURVES	9

Horizontal and vertical control – Methods – triangulation- baseline – satellite stations – reduction to centre – Route Surveying - Route surveys for highways, and railways - Simple curves – Compound curve and reverse curves – Transition curves - different methods of Setting out simple curve & vertical curves.

Unit IV	MODERN SURVEYING	9

Total Station - Parts and accessories - working principle - On board calculations - Fundamental quantities measured - Field procedure and applications - Errors and Good practices. Basics of GIS - GPS Surveying - Different segments - satellite configuration - Anti Spoofing and Selective Availability - Hand Held and Geodetic receivers - data processing – Errors in GPS Surveying - Field procedure and applications.

Unit V	PHOTOGRAMMETRY AND REMOTE SENSING	9

Photogrammetry – Introduction, Basic concepts, perspective geometry of aerial photograph, photographic scale-flying heights and altitude – relief and tilt displacements, terrestrial Photogrammetry - Flight planning – Drone surveying and applications. Remote sensing: Introduction- Electromagnetic spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the concepts of component parts of Conventional and Modern survey equipment and methods.	Understand
CO.2	Apply the conventional and modern surveying technique to measure the Horizontal distance, included angles, Difference in Elevations, area and volume by Direct or Indirect methods.	Apply
CO.3	Design the concepts of GIS, GPS.	Apply
CO.4	Design the simple curves and routes for Highway and railways using Modern survey equipments	Apply
CO.5	Analyse the errors and corrections of various surveying methods.	Analyze
CO.6	Investigate the Purpose and Characteristics of Various Curves, Route Surveying and Triangulation Surveying .	Analyze

Text Books:

1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 & 2, Pune VidyarthiGriha Prakashan, Pune, 2014 .
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2016.
3. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2014.
4. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
5. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 2004.
6. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014.

Reference Books:

1. Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 4rd Edition, 2015.
2. GuochengXu, “GPS Theory , Algorithms and Applications”, Springer – Berlin, 2016.
3. Satheesh Gopi, rasathishkumar, N. madhu, “Advanced Surveying, Total Station GPS and Remote Sensing” Pearson education, 2019.
4. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2011.
5. AroraK.R.,"SurveyingVol I & II", Standard Book house, 10th Edition 2018.

21UCE307	MATERIAL TESTING LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- To apply knowledge of mathematics and engineering in calculating the mechanical properties of structural materials.
- To use the techniques, skills and modern engineering tools necessary for engineering.
- To understand the professional and ethical responsibility in the areas of material testing.

LIST OF EXPERIMENTS

I. Test on Cement

1.Fineness of Cement

2.Determination of Soundness

3.Determination of Consistency

4.Determination of Initial and Final setting time

II. Test on Bricks and Blocks

1.Test for Compressive strength of bricks and blocks

2.Test for water absorption of bricks and blocks

3.Determination of Efflorescence of bricks

III. Test on Metals

1.Tension test on MS rod and HYSD rod

2.Torsion Test

3.Double Shear Test

4.Impact Test (Izod and Charpy)

5.Fatigue Test

6.Deflection Test on Metal Beam

IV. Test on Springs

1.Tension Test on Open Coiled Helical Spring

2.Compressive Test on Open Helical Spring

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Determine the stress, strain, deformation of metal under different types of loadings.	Apply
CO.2	Determine the quality of cement with regard to their suitability in construction.	Apply
CO.3	Determine the mechanical properties of metals and springs.	Apply
CO.4	Analyse the classification of hollow blocks and bricks based on its mechanical properties as per IS code.	Analyze
CO.5	Make use of problem solving approaches to various current issues regarding failure of structures due to unsuitable materials and make decisions in teams.	Respond
CO.6	Justify the suitability of Cement, Metals, hollow blocks and bricks as per IS code for construction based on its physical and mechanical properties and submit your report.	value

References:

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth Heinemann.
2. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materials used for Civil Engineering applications .
3. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella.
4. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition .
5. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards (post 2000).

21UCE308	SURVEYING LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- To impart knowledge on setting out of building and curves using chain and Theodolite.
- To familiarize the concepts on LS, CS, area and volume calculations.
- To impart knowledge on making measurements using modern survey techniques.

LIST OF EXPERIMENTS

I. Chain Surveying and Compass Surveying

1.Aligning, Ranging, Chaining and Setting out

2.Compasstraversing

II. Levelling

1.Fly Levelling using Dumpy level

2.Fly Levelling using Tilting level

3.Check Levelling

4.Contouring, LS and CS

III. Theodolite &Tachometric Surveying

1.Measurement of Horizontal and Vertical angle using Theodolite.

2.Measurement of heights, distances and Gradient by single plane and double Plane method.

3.Measurement of heights, distances and Gradient using stadia and tangential system of Tachometry.

4. Setting out of a Simple Circular curve using Theodolite surveying.

IV. Total Station Surveying

1. Determination of angles and height measurement using total station.
2. Determination of area of a given boundary using total station.

V. GPS Surveying

1. Determine the length of given objects using GPS.
2. Determine the area of given boundary by GPS.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

After successful completion of this course, the students will be able to

COs	CO Statements	BT Levels
CO.1	Determine the stress, strain, deformation of metal under different types of loadings (axial, torsion, bending).	Apply
CO.2	Determine the quality of cement with regard to their suitability in construction.	Apply
CO.3	Determine the mechanical properties of metals and springs.	Apply
CO.4	Analyse the classification of hollow blocks and bricks based on its mechanical properties as per IS code.	Analyze
CO.5	Make use of problem solving approaches to various current issues regarding failure of structures due to unsuitable materials and make decisions in teams.	Analyze

REFERENCES:

1. Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 3rd Edition, 2004.
2. Guocheng Xu, “GPS Theory, Algorithms and Applications”, Springer – Berlin, 2003.
3. SatheeshGopi, Rasathishkumar, N.Madhu, “Advanced Surveying, Total Station GPS and Remote Sensing” Pearson education, 2007
4. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.
5. Arora K.R.,"Surveying Vol I & II", Standard Book house, 10th Edition 2008.

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IV SEMESTER

21UMA423	NUMERICAL METHODS(only for Civil)	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To acquaint the student with the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and Eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.
- To familiarize the student with the methods discussed on interpolation which will be useful in constructing approximate polynomial to represent the data and to find the intermediate values, when huge amounts of experimental data are involved.
- To make the student acquire sound knowledge in applications of numerical methods in various fields, solving practical technical problems using scientific and mathematical tools when available in Engineering.

Unit I	**SOLUTION OF ALGEBRAIC, TRANCENDENTAL EQUATIONS AND EIGENVALUE PROBLEMS**	**9+3**

Iteration method – Newton- Raphson method – Gauss Elimination method – Pivoting – Gauss Jordan methods –iterative methods : Gauss Jacobi method ,Gauss Seidel method - Eigen values of a matrix by Power method – Jacobi's method for a real symmetric matrix.

Unit II	**INTERPOLATION AND APPROXIMATION**	**9+3**

Lagrange's interpolation – Newton's divided difference interpolation – Newton's forward and backward difference interpolation –cubic spline.

Unit III	**NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**9+3**

Derivatives from difference tables – Divided differences and finite differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two point and Three point Gaussian quadrature formulae - Double integrals using Trapezoidal and Simpson's rules.

Unit IV	**NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**

Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

Unit V	**NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations

TOTAL : 45 (L) + 15 (T) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply various techniques to solve linear, nonlinear equations and Eigen value problems of a Matrix by Numerically.	Apply
CO.2	Apply Interpolation technique for equal and unequal intervals to find new data points within the range of known data points.	Apply
CO.3	Apply the Numerical techniques of Differentiation and Integration for Engineering Problems.	Apply
CO.4	Apply the knowledge of numerical techniques and methods for solving first and second order Ordinary Differential Equation.	Apply
CO.5	Apply the knowledge of Partial Differential Equation with initial and boundary conditions by using certain techniques with engineering applications.	Apply
CO.6	Apply the knowledge of parabolic, elliptic, eigenvalues and ordinary differential equation.	Apply

Text Books:

1. SASTRY S.S., "Introductory methods of Numerical Analysis", Prentice Hall of India, New Delhi, 4th Edition,(2008).
2. 2. SRIMANTAPAL "Numerical methods Principles Analysis and Algorithm", Edition 2009, Oxford press,
3. 3. IYENGAR S.R.K , JAIN R.K. , MAHIDEN KUMAR JAIN " Numerical Methods for

Reference Books:

1. KANDASAMY.P, THILAGAVATHY.K and GUNAVATHY.K, "Numerical Methods", S.Chand Co. Ltd., New Delhi, (2003).
2. GERALD C.F. and WHEATELEY P.O., "Applied Numerical Analysis", Pearson Education, New Delhi, 6th Edition, (2006).
3. GREWAL B.S. and GREWAL J.S., "Numerical methods in Engineering and Science", Khanna Publishers, New Delhi, 9th Edition, (2007).
4. CHAPRA S. C and CANALE R. P. "Numerical Methods for Engineers", Tata McGraw-Hill, New Delhi, 5th Edition, (2007).
5. SANKAR RAO.K, "Numerical Methods for scientists and engineers", Prentice Hall of India, New Delhi, 3rd Edition, (2007).

21UCE402	SOIL MECHANICS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties.
- To familiarize the fundamental concepts of permeability, stress transformation, compaction, and consolidation.
- To understand the shear strength parameters on various geotechnical applications.
- To provide the knowledge on behaviour and the performance of soil on stress distribution.
- To acquire knowledge on design and analysis of both finite and infinite slopes.

Unit I	BASIC PROPERTIES OF SOIL	

Introduction - Soil formation – History and Types of soil -Phase relation – Engineering and index properties - Grain size distribution – Atterberg limits – Soil classification significance – BIS classification system.

Unit II	PERMEABILITY AND STRESS DISTRIBUTION	9

Introduction- Permeability – Darcy's law - Laboratory methods – Field methods - Quick sand condition - Seepage – Laplace equation - Flow nets – properties and applications –Liquefaction - Stress distribution- Effective stress concepts – Boussinesq's equation – Stress due to line load and circular and rectangular loaded area – Westergaard's equation for point load – Newmark's Influence Chart.

Unit III	COMPACTION AND CONSOLIDATION	9

Introduction-compaction- Influencing factors - laboratory and field methods- Settlement - Components - Immediate and consolidation settlement- Terzaghi's one dimensional consolidation theory - Laboratory consolidation test – Field consolidation curve – NC and OC clays - Final and time rate of consolidation– $\sqrt{t}$ and log t methods.

Unit IV	SHEAR STRENGTH	9

Introduction- Shear strength of soil – Mohr–coulomb's theory – Measurement of shear strength - Direct shear test, UCC test, triaxial shear test and vane shear test - Shear strength of cohesive and cohesionless soil- Pore pressure parameters – Factors influences shear strength of soil.

Unit V	SLOPE STABILITY	9

Slope failure mechanisms - Modes - Stress analysis - Infinite and finite slopes - Stability analysis for purely cohesive and c-Φ soils - Method of slices – Friction circle method - Stability number – Slope protection measures.

TOTAL – 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the various soil types, its characteristics and testing its engineering properties.	Understand
CO.2	Apply the knowledge of engineering fundamentals to determine the soil properties, strength, and stability of slope.	Apply
CO.3	Apply the knowledge of various Soil Mechanics theories and experimental studies to predict the stress equations and different failure modes of soil	Apply
CO.4	Analyse the various properties of different soil samples including stress distribution settlement and bearing capacity.	Analyze
CO.5	Investigate the merits and demerits of various soil tests and theories to compute an appropriate solution for the given scenario.	Evaluate
CO.6	Evaluate the various soil testing methods to provide a suitable method for determining the soil parameters.	Evaluate

Text Books:

1. Punmia, B.C. Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, sixteenth edition,2017.
2. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2018.

Reference Books:

1. IS2720 – Code of Practice for soil test and IS 7894 – Code of Practice for stability od earthen dams.
2. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International Publishers, Third edition, 2016.
3. Arora K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2013.
4. Venkatramaiah, C. "Geotechnical Engineering", New Age International Publishers, New Delhi, Sixth edition, 2018.
5. MuniBudhu. "Soil Mechanics and Foundations". Wiley India Edition, 2016.

21UCE403	STRUCTURAL ANALYSIS – I	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To Analyze the pin-jointed plane and space truss.
- To analyse the indeterminate structures for internal forces by slope deflection method&Moment distribution method.
- To learn the method of drawing influence lines and its uses in various applications like beams, bridges and plane trusses.
- To analyse the arches and suspension bridges

Unit I	ANALYSIS OF TRUSSES	12

Determinate and indeterminate trusses - analysis of determinate trusses - method of joints -method of sections - Deflections of pin-jointed plane frames - lack of fit - change in temperature - method of tension coefficient - application to space trusses.

Unit II	SLOPE DEFLECTION METHOD	12

Slope deflection equation- Analysis of continuous beams and rigid frames - Support settlements.

Unit III	MOMENT DISTRIBUTION METHOD	12

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams - Plane rigid frames with and without sway – Support settlement.

Unit IV	MOVING LOADS AND INFLUENCE LINES	12

Influence lines for reactions in statically determinate structures –Influence lines for shear force and bending moment in beam sections – Calculation of critical stress resultants due to concentrated and distributed moving loads - Muller Breslau"s principle – Application of Muller Breslau"s principle to propped cantilever and two span continuous beams - Indirect model analysis forinfluence lines of indeterminate structures – Beggs deformeter.

Unit V	ARCHES	12

Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.

TOTAL - 60 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the concepts and principles of bending theory, column theory and failure theories.	Understand
CO.2	Apply various methods to compute shear force, bending moment and deflection of determinate and indeterminate beams .	Apply
CO.3	Determine load carrying capacity and stresses induced in columns, cylinders, spherical shells and hooks.	Apply
CO.4	Analyze the beams and columns for different support conditions and cylinder, spherical shells and curved beams for different loading conditions.	Analyze
CO.5	Investigate reinforcement and deflection distribution as per SFD & BMD and codal provisions respectively.	Analyze
CO.6	Investigate stress strain distribution of beams, columns, cylinders and spherical shells using any analysis software.	Evaluate

Text Books:

1. Bhavikatti, S.S, Structural Analysis,Vol.1,& 2, Vikas Publishing House Pvt.Ltd.,NewDelhi-4, 2014.
2. Punmia, B.C., Arun Kumar, Ashok Kumar., Theory of structures, Laxmi Publications, New Delhi, 2014.

Reference Books:

1. William Weaver, Jr and James M.Gere, Matrix analysis of framed structures, CBS.
2. Publishers & Distributors, Second Edition, Delhi, 2004.
3. Reddy .C.S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.
4. Negi L.S. and Jangid R.S., Structural Analysis, Tata McGraw Hill Publishing. Co. Ltd. 2004.
5. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing HousePvt.Ltd.,New Delhi-4, 2014.

21UCE404	WASTE WATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To develop the ability to apply basic understanding of physical, chemical, and biological phenomena for successful design,operation and maintenance of sewage treatment plants.
- To have adequate knowledge about the basic concepts of sewage composition and various sewage treatment processes and its design.
- To provide the adequate information on various disposal standards for industrial effluents.

Unit I	PLANNING AND DESIGN OF SEWERAGE SYSTEM	9

Characteristics and composition of sewage -- population equivalent -Sanitary sewage flow estimation – Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design - Storm runoff estimation – DWF and WWF - sewer appurtenances – sewage pumping-drainage in buildings-plumbing systems for drainage - Discharge standards for Effluents - General layout of house drainage - street connections

Unit II	PRIMARY TREATMENT OF SEWAGE	8

Objectives – Unit Operations and Processes – Selection of treatment processes – Onsite sanitation - Septic tank- Primary treatment – Principles, functions, design, Operation and Maintenance aspects of sewage treatment units - screens - grit chamber - primary sedimentation tanks.

Unit III	SECONDARY TREATMENT OF SEWAGE	10

Objectives – Selection of Treatment Methods – Principle, Functions, design and Operation and Maintenance - Activated Sludge Process and Extended aeration systems – Rotating biological contactors -Trickling filters Waste Stabilization Ponds.

Unit IV	ADVANCES IN SEWAGE TREATMENT	8

Sequencing Batch Reactor – Moving bed biofilm reactor - Membrane Bioreactor – Anaerobic digestion - Reclamation and Reuse of sewage – Constructed Wetland - Nutrient removal systems - Operation and Maintenance.

Unit V	SEWAGE DISPOSAL AND SLUDGE MANAGEMENT	10

Dilution – Self-purification of surface water bodies - Oxygen sag curve – deoxygenation and reaeration - Land disposal – Sewage farming – sodium hazards - Soil dispersion system. Objectives - Sludge characterization – Sludge Thickening – Dewatering – Drying – ultimate residue disposal – UASB – Biogas Recovery - Septage Management.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the concepts of wastewater sources, sludge composition and various sewage treatment processes.	Understand
CO.2	Apply the knowledge of sewage flow principles to calculate the sewage generation, design of sewer pipe line, wastewater treatment process and sludge disposal methods.	Apply
CO.3	Analyze the quality of sewage to decide the treatment process, sewer appurtenances and disposal methods.	Analyse
CO.4	Design the sanitary sewer system, wastewater treatment process and characteristics of sludge that meet the discharge standards.	Apply
CO.5	Evaluate the wastewater characteristics to provide valid conclusion for treatment processes and disposal methods.	Evaluate
CO.6	Select and apply appropriate advanced treatment techniques using autocad .	Apply

Text Books:

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers,New Delhi, 2015.
2. Duggal K.N., “Elements of Environmental Engineering” S.Chand and Co. Ltd., New Delhi, 2014.
3. Punmia B.C, Jain A.K and Jain A.K, “Environmental Engineering Vol-II” Laxmi Publications, 2010.

Reference Books:

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, NewDelhi, 2010.
3. Syed R. Qasim “Wastewater Treatment Plants”, CRC Press, Washington D.C.,2010.
4. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd., New Delhi, 2006.

21UCE405	HIGHWAY ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To give an overview about the highway engineering with respect to, planning, design, construction and maintenance of highways as per IRC standards, specifications and method
- To introduce the fundamentals related to the Planning and design of road components.
- To provide knowledge on various materials of pavement construction and method of design of highway construction.

Unit I	HIGHWAYPLANNING AND ALIGNMENT	9

Significance of highway planning – Modal limitations towards sustainability – History of road development in India – factors influencing highway alignment – Soil suitability analysis – Road ecology – Engineering surveys for alignment, objectives, conventional and modern methods – Classification of highways – Locations and functions – Typical cross sections of Urban and Rural Roads.

Unit II	GEOMETRICDESIGNOFHIGHWAYS	9

Crosssectionalelements–Sightdistances–
Horizontalcurves,Superelevation,transitioncurves,wideningatcurves–Verticalcurves–
Gradients,Specialconsiderationforhillroads–Hairpinbends-Lateralandverticalclearanceatunderpasses.

Unit III	DESIGNOFFLEXIBLE ANDRIGIDPAVEMENTS	9

Pavement components and their role — Design principles -Design practice for flexible and rigidPavements(IRCmethodsonly)–Embankments-ProblemsinFlexiblepavementdesign.

Unit IV	HIGHWAYCONSTRUCTIONMATERIALS ANDPRACTICE	9

Highway construction materials, properties, testing methods – CBR Test for sub grade – tests onaggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materialsand methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling,Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Qualitycontrolmeasures–Highwaydrainage—Constructionmachineries.

Unit V	EVALUATION ANDMAINTENANCEOFPAVEMENTS	9

Pavement distress in flexible and rigid pavements — Types of maintenance — PavementManagement Systems – Pavement evaluation,roughness,present serviceability index,skidresistance,structuralevaluation,evaluationby deflectionmeasurements–Strengtheningofpavements–HighwayProjectformulation.

TOTAL: 45 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Formulate the highway alignment using the engineering surveys.	Understand
CO.2	Design the sectional elements of the horizontal curves.	Apply
CO.3	Demonstrate the need for gradient in horizontal curves .	Create
CO.4	Design pavement mixes using the alternative materials such as Geotextiles & Plastics.	Apply
CO.5	Investigate the characteristics of modern materials used in road construction.	Evaluate
CO.6	Evaluate the pavements based on deflection and service conditions.	Evaluate

Text Books:

1. Khanna.S.K.,Justo.C.E.GandVeeraragavanA.—HighwayEngineering‖,NemchandPublishers,2014.
2. SubramanianK.P.,—Highways,Railways,AirportandHarbourEngineering‖,ScitechPublications(India),Chennai,2010
3. Kadiyali.L.R.—PrinciplesandPracticeofHighwayEngineering‖,KhannaTechnicalPublications,8thedition Delhi,2013

Reference Books:

1. ReferenceBooks:
2. Agarwal,M.M.,—IndianRailwayTrack‖,SachdevaPress,NewDelhi,2013.
3. Mundrey.J.S.,—RailwayTrackEngineering‖TataMcGraw-HillEducation,2009.

21UCE406	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart basic knowledge about the open channel flows with analysis of uniform flow, gradually varied flows and rapidly varied flows.
- To impart knowledge on performance characteristics of turbines.
- To impart knowledge on performance characteristics of pumps.

Unit I	UNIFORM FLOW	9

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel – Types and Regimes of flow - Velocity distribution in open channel – Modern flow measuring Techniques in Open Channel Flow - - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow – Wide open channel - Specific energy – Critical flow and its computations.

Unit II	GRADUALLY VARIED FLOW	9

Dynamic equation of gradually varied flow – drawdown and backwater curves - Types of flow profiles - Classifications: Computation by Direct step method and Standard step method – Change in Grades.

Unit III	RAPIDLY VARIED FLOW	9

Application of the momentum equation for Rapidly varied Flow - Hydraulic jumps - Types - Energy dissipation – positive and negative surges (Basic Concepts Only)

Unit IV	TURBINES	9

Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines - Francis turbine - Kaplan turbine - Draft tube - Cavitations - Performance of turbine - Specific speed - Runaway speed.

Unit V	PUMPS	9

Classification of Pumps - Centrifugal pumps – work done - Cavitations in pumps - specific speed of pump - characteristics Curves - Multistage pumps - Reciprocating pumps - Negative slip - Indicator diagrams and its variations - Air vessels - Savings in work done.

TOTAL: 45 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the basic concepts of open channel flows and hydraulic machines.	Understand
CO.2	Determine the characteristics of open channel flow and hydraulic machines.	Apply
CO.3	Analyze the various flow profiles in open channel flow using different methods.	.Analyze
CO.4	Evaluate the fluid flow characteristics in open channels under various flow conditions and efficiencies of turbines and pumps based on head, specific speed and discharge.	Evaluate
CO.5	Create a model/Program of hydraulic structures using engineering services to predict the fluid flow.	Apply
CO.6	Make an effective communication and presentation as an Individual/team in hydraulic Engineering related problems.	Apply

Text Books:

1. Bansal R.K. Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2018.
2. K. Subramaniya, Flow in open Channels.
3. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 2002.

Reference Books:

1. VenTe Chow, Open Channel Hydraulics , McGraw Hill , New York, 2009.
2. Rajesh Srivastava, Flow through open channels, Oxford University Press, NewDelhi, 2008.
3. Rajput R.K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, Ninth Edition 2010

21UCE407	WATER AND WASTEWATER ANALYSIS LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- To convey the principles of testing of water and wastewater.
- To carryout air and noise pollution measurements.
- To provide analyzing methods for water and waste water with modern tools.

LIST OF EXPERIMENTS

1. Sampling and preservation methods and significance of characterization of water and Waste water. (Demonstration only).
2. Determination of
   (i) pH and turbidity
   (ii) Hardness
3. Determination of iron & fluoride using spectrophotometer
4. Determination of alkalinity
5. Determination of Chlorides
6. Determination of Ammonia Nitrogen using spectrophotometer
7. Determination of Sulphate
8. Determination of Optimum Coagulant Dosage
9. Determination of available Chlorine in Bleaching powder
10. Determination of dissolved oxygen
11. Determination of suspended, volatile and fixed solids
12. Determination of BOD
13. Determination of COD
14. Determination of heavy metal using AAS.
15. Determination of air quality with ambient dust sampler.
16. Determination of ambient noise.
17. Determination of MPN index of given water sample (Demonstration only).

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Determine the physical and chemical characteristics of given water, wastewater and sample.	Apply
CO.2	Use modern equipment in prediction of ambient air quality and micro level contaminants.	Apply
CO.3	Select suitable methods and perform tests for water and waste water.	Analyze
CO.4	Suggest suitable design treatment technology for the given wastewater.	Analyze
CO.5	Investigate the quality of water and wastewater samples based on the level of contamination.	Apply
CO.6	Examine the microbial contaminants present in wastewater to adopt modern techniques.	Evaluate

References:

1. Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998.
2. 2. Garg, S.K., “Environmental Engineering Vol. I & II”, Khanna Publishers, New Delhi.
3. 3. Modi, P.N., “Environmental Engineering Vol. I & II”, Standard Book House, Delhi-6 .

IS Codes:

1. IS 3025 (Part 1-60) Indian Standard Methods of sampling and test (physical and Chemical) for water and wastewater.
2. IS 10500: 2012 Indian Standard Drinking Water Specifications.
3. CPCB air pollution std.
4. IS 3025 (Part 1-60) Indian Standard Methods of sampling and test (physical and Chemical) for water and wastewater.

21UCE408	HYDRAULIC ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- To provide fundamental knowledge on properties of fluid flow and flow measuring devices.
- To familiarize the determination of major and minor losses in pipes.
- To provide hands on experience in characteristics of pumps and turbines.

LIST OF EXPERIMENTS

1. Flow measurement using Rotameter.
2. Flow through Venturimeter and Orifice meter.
3. Flow through Notches.
4. Bernoulli's Experiment.
5. Friction factor estimation in pipes .
6. Minor losses in Pipes with enlargement and contraction.
7. Characteristics of Centrifugal pumps.
8. Characteristics of Submersible pump.
9. Characteristics of Reciprocating pump .
10. Characteristics of Pelton wheel turbine.
11. Characteristics of Francis turbine.
12. Determination of Metacentric height.
13. Study of Pressure Measuring Devices.
14. Hydrostatic force on Flat Surfaces[Normal / Inclined].

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the concept of fluid Mechanics to measure the various fluid static and Dynamic Parameters.	Apply
CO.2	Categorize the performance of flow measuring devices under varying flow conditions.	Analyze
CO.3	Demonstrate the concept of Stability of floating bodies.	Analyze
CO.4	Evaluate the performance characteristics of Pumps and Turbines.	Evaluate
CO.5	Analyze a variety of practical fluid-flow devices and utilize hydraulic principles in design.	Analyze
CO.6	Analyze the flow through pipes inclusive of their head losses.	Analyze

Text Books:

1. Dr.R.K.Bansal Fluid Mechanics and Hydraulic Machines,Laxmi Publication Private Ltd. New Delhi 2018.
2. Sarbjit Singh. Experiments in Fluid Mechanics, PHI Learning Private Ltd., New Delhi 2009.
3. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House, New Delhi, 2000.
4. Subramanya, K. Flow in open channels, Tata McGraw - Hill pub. Co., 2000.

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V SEMESTER

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21UCE501	STRUCTURAL ANALYSIS – II	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To introduce the importance of plastic analysis to calculate the collapse loads for beams and frames.
- To formulate the element stiffness matrix and assemble the structure stiffness matrix for solving indeterminate problems.
- To analyse statically indeterminate structures by imposing boundary conditions on flexibility matrix.
- To analyse the suspension bridges and space truss.

Unit I	PLASTIC ANALYSIS OF STRUCTURES	12

Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.

Unit II	MATRIX STIFFNESS METHOD	12

Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.

Unit III	MATRIX FLEXIBLITY METHOD	12

Degree of Static Indeterminacy -Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

Unit IV	SPACE AND CABLE STRUCTURES	12

Analysis of Space trusses using method of tension coefficients – Beams curved in plan - Suspension cables – suspension bridges with two and three hinged stiffening girders.

Unit V	APPROXIMATE ANALYSIS OF FRAMES	12

Approximate analysis for gravity loadings – substitute frame method for maximum moments in beams and columns – Approximate analysis for horizontal loads – portal method and cantilever method – assumptions – axial force, shearing force and bending moment diagrams.

TOTAL - 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the fundamental principles of analysis of beams, pin jointed frames, rigid frames and arches.	Understand
CO.2	Compute the member forces and deflection of determinate and indeterminate structures.	Apply
CO.3	Apply the slope defection and moment distribution methods to solve the beams and rigid frames under different loading conditions.	Apply
CO.4	Analyze the support moments, Shear forces for statically indeterminate and determinate structures using various analytical methods.	Analyze
CO.5	Analyze the vertical reaction, horizontal thrust and bending moment for two and three hinged arches.	Analyze
CO.6	Investigate the SFD & BMD of determinate and indeterminate structures using classical methods and modern tools.	Evaluate

Text Books:

1. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt.Ltd., NewDelhi-4, 2014.
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications,2004

Reference Books:

1. Negi.L.S and JangidR.S ., Structural Analysis , Tata McGraw-Hill Publishers, 2004.
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co. Ltd., Third Edition,2010.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHI Learning Pvt. Ltd., 2011.
4. Vazrani.V.N And Ratwani,M.M, Analysis of Struc.

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21UCE502	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To acquire knowledge on planning and execution of geotechnical site investigation.
- To understand the design parameters of different type of foundations as per code.
- To familiarize the concept of earth pressure theories and retaining wall analysis.
- To understand the pile foundation, its type, capacity and settlement.
- To impart knowledge on basic concepts of special foundation.

Unit I	Site Investigation and Selection of Foundation	9

Introduction – Scope and objectives – Methods of exploration – Depth of boring- spacing of bore hole – Standard penetration test – significance – sampling – types, techniques and requirements- Bore log and report writing – data interpretation- strength parameters and liquefaction potential – Selection of foundation based on soil condition.

Unit II	Bearing Capacity and Settlement of Shallow Foundation	9

Introduction – Types - Location and depth of foundation – Codal Provisions - Bearing capacity of shallow foundation – Terzaghi's theory, Meyerhoff's theory and BIS formula – Factors affecting bearing capacity - In-situ tests (Plate load, SPT and SCPT) – allowable bearing pressure - Seismic considerations in bearing capacity evaluation – Determination of settlement of foundations on granular and clay deposits – Total and differential settlement – Methods of minimizing settlements.

Unit III	Pile Foundation	9

Introduction – Types of piles and their function – Factors influencing the selection of pile – Load carrying capacity of single pile in granular and cohesive soil – Static formula - Dynamic formulae – Capacity from in-situ tests (SPT and SCPT) – Negative skin friction – Uplift capacity – Group capacity by different methods (Feld's rule, Converse-Labarre formula and block failure criterion) - Pile load test & Interpretation – Under reamed piles - Settlement of pile groups – Codal provision.

Unit IV	Earth Pressure and Retaining Walls	9

Introduction – Types of retaining wall - Plastic equilibrium in soils – Active and passive states – Rankine's theory- Cohesionless and cohesive soil - Coulombs wedge theory – Condition for critical failure plane – Graphical methods – Rebhann and Culmann methods – Determination of earth pressures by analytical methods - stability analysis for retaining walls – Codal Provision.

Unit V	Raft and Special Foundation	9

Introduction – Raft and Pile Raft – Types – Design – Bearing capacity and Settlement - Machine Foundation (Principles only) - Foundations of transmission line towers – data requirements – forces - choice of foundation type - design procedure only - Well foundation - Tilt and shift - Remedial measures- Bearing capacity - methods of construction - settlement - lateral stability – Recent scenario.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the concept of exploration techniques, earth pressure analysis for various types of foundations.	Understand
CO.2	Apply the knowledge of sub-surface investigation, various foundation types and testing its capacity, to find the solution for geotechnical problems.	Apply
CO.3	Present the failures in slopes and suggest appropriate improvement methods for foundation.	Apply
CO.4	Analyze the bearing capacity of different foundations using the principles of various theories, exploration techniques and in-situ tests.	Analyze
CO.5	Evaluate the earth pressure, safe load, and settlement to provide a suitable foundation by examining the safety and economic conditions.	Evaluate
CO.6	Design the foundation and retaining structure based on the load carrying capacity and settlement with appropriate consideration for safety.	Create

Text Books:

1. Venkatramaiah, C. “Geotechnical Engineering”, New Age International Publishers, New Delhi, 2017.
2. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers and Distributers Ltd., New Delhi, 2015.
3. Arora K.R. “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 2011.
4. Punmia, B.C. Soil Mechanics and Foundations”, Laxmi Publications Pvt.Ltd., New Delhi, 2005.
5. Venkatramaiah, C. “Geotechnical Engineering”, New Age International Publishers, New Delhi, 2017.

Reference Books:

1. GopalRanjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi, 2016.

2. Varghese, P.C.,"Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2012.
3. Das, B.M, "Principles of Geotechnical Engineering", Thompson Brooks/ Coles Learning, Singapore, 5th Edition, 2014.
4. Purushothma Raj P "Soil Mechanics and Foundation Engineering" 2nd Edition, Pearson Education, 2013.
5. Bowles J.E, "Foundation Analysis and design", McGraw-Hill, 1994.

IS Codes: (If necessary for your course)

1. IS 6403 - Code for practice of bearing capacity of shallow foundation.
2. IS 2911 - Code for practice of Pile foundation (Section 1 & 2).
3. IS 5121-1969 – safety coding of pile.
4. IS 2950 -1 (1981) – Code of Practice for design and Construction of raft foundation.
5. IS 14458 – 1997 Guidelines for Retaining wall on hill area (Part 1 & 2)

21UCE503	DESIGN OF REINFORCED CONCRETE ELEMENTS	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To Impart the usage of codes for strength, serviceability and durability.
- To have knowledge in designing various structural elements design and detail the basic elements like beam, slab, column, footing and staircase.
- To afford knowledge in analysis and design of RC framed structures including planning and drawings

Unit I	INTRODUCTION TO WORKING STRESS AND LIMIT STATE METHODS	6+3

Assumptions made in the working stress method – Permissible stresses – Flexural members - moment of resistance of singly and doubly reinforced rectangular sections - - Concepts of limit state design, Characteristic loads, Characteristic strength, Partial loads and Material Safety factors, Representative stress, strain curves, Assumptions in limit state design, Stress block parameters, moment of resistance of singly and doubly reinforced rectangular sections.

Unit II	DESIGN OF SLABS	7+3

Design of one-way slabs, two-way slabs, Continuous slabs using IS coefficients. Draw reinforcement detailing as per SP 34.

Unit III	DESIGN OF BEAMS	12+3

Limit state analysis and design of singly reinforced, doubly reinforced beams - Limit state design of T and L beam sections - Limit state analysis and design of sections for shear and torsion, Concept of bond, anchorage and development length, I.S Code provisions. Design examples in simply supported beams. Draw reinforcement detailing as per SP 34.

Unit IV	DESIGN OF COLUMNS	8+3

Types of columns – Design of short columns for axial load, combined axial load with uniaxial and biaxial bending - use of design aids. Draw reinforcement detailing as per SP 34.

Unit V	DESIGN OF FOOTINGS AND STAIRCASE	12+3

Footings: Different types of footings–Design of isolated, square, rectangular and circular footings. Types of stairs – Types of Staircases – Design of dog-legged and open well Staircase. Draw reinforcement detailing as per SP 34.

TOTAL 45(L) + 15(P) = 60 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the code provisions for the design of structural elements.	Understand
CO.2	Apply the limit state concepts for the design of structural elements.	Apply
CO.3	Analyze the safety and serviceability requirements of various structural elements as per IS code.	Analyze
CO.4	Analyze the reinforcement detailing of various structural elements as per IS code.	Analyze
CO.5	Create the models of structural elements for the Engineering community.	Analyze
CO.6	Construct the reinforcement detailing of structural elements as per IS codes using Auto CADD software.	Apply

Text Books:

1. Krishnaraju.N " Design of Reinforced Concrete Structures ", CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2015.
2. Ramachandra, "Limit state Design of Concrete Structures" Standard Book House, New Delhi, 2018.
3. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2010.
4. Pillai&DevdasMenon, "Reinforced concrete design", 3rd Edition, Tata McGraw Hill, New Delhi, 2009.

Reference Books:

1. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2009.
3. Punmia. B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publication Pvt. Ltd., New Delhi, 2007.

IS CODES:

1. IS 456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000.
2. SP16: "Design Aids for Reinforced Concrete to IS 456, New Delhi, 1999.
3. Sp 34 - 1987 Handbook on Concrete Reinforcement and Detailing.

21UCE507	CREATIVE THINKING AND INNOVATION	L	T	P	C
		0	0	2	1

Course Learning Objectives:

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses.
- To use a range of creative thinking tools to develop Out of the Box Ideas.

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice Valuing – Affective Domain	Valuing – Affective Domain
CO.2	Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development Organization – Affective Domain	Organization – Affective Domain
CO.3	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task . Affective Domain.	Affective Domain.
CO.4	Apply modern techniques to provide valid conclusion following the norms of engineering practice. (Apply)	Apply
CO.5	Analyze the market potential and evolve the product strategy.	Analyse
CO.6	Develop sustainable innovative solutions for societal issues with consideration for public health, safety and environment.	Create

21UCE508	SOIL MECHANICS LABORATORY	L	T	P	C
		0	0	3	1.5

Course Learning Objectives:

- To give exposure on classification of soil based on index properties.
- To provide knowledge on the shear strength of the given soil.
- To study about the compressibility of soil sample.

LIST OF EXPERIMENTS

Index Properties

1. Specific gravity of soil grains.
2. Grain size distribution - Sieve analysis.
3. Wet Sieve analysis – Hydrometer test (Study).
4. Relative density of sand.
5. Atterberg's limits test - Differential free swell test.
6. Determination of Moisture - Density relationship using Standard Proctor Test.
7. Permeability determination (constant head and falling head methods).

Determination of shear strength parameters by

8. Direct shear test on cohesion less soil .
9. Unconfined compression test on cohesive soil .
10. Triaxial compression test (Study).
11. One dimensional consolidation test (Determination of co-efficient of consolidation only).
12. Field density test (Core cutter and sand replacement methods).
13. Determination of CBR Value of various soil types.

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the knowledge of soil mechanics to find the index properties of soil.	Apply
CO.2	Apply the concepts of Cohesion and consolidation to find the shear strength parameters of soil.	Apply
CO.3	Analyze the Moisture Density relationship, nature of flow and Grain size distribution of the given soil sample.	Analyze
CO.4	Evaluate the CBR value of various soil types and investigate the suitability of soil for various applications.	Evaluate
CO.5	Make use of problem solving approaches to various current issues regarding failure of soil.	Apply
CO.6	Justify the suitability of various soil stabilization techniques based on its physical and mechanical properties and submit your report.	Apply

REFERENCES:

1. IS2720 – Code of Practice for Index and Engineering Property test for Soil.
2. Punmia, B.C. Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, sixteenth edition,2017.
3. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2018.

21UCE509	SURVEY CAMP (During IV semester Summer Vacation 2 weeks)	L	T	P	C
		0	0	0	2

Course Learning Objectives:

The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. The camp must involve work on a large area of not less than 40 acres outside the campus (Survey camp should not be conducted inside the campus). At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.

LIST OF EXPERIMENTS

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Triangulation Survey.
2. Trilateration Survey.
3. Contouring.
   i. Radial tachometric contouring - Radial Line at Every 45 Degree and Length not Less than 60 Meter on each Radial Line.
   ii.Block Level/ By squares of size at least 100 Meter x 100 Meter at least 20 Meter interval.
   iii.L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter at least LS at Every30M and C.S at every 90m.
4. Offset of Buildings and Plotting the Location.
5. Use of GPS to determine latitude and longitude and locate the survey camp location.
6. Traversing using GPS.
7. Traversing using Total station.

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply modern surveying techniques in field to establish horizontal control.	Apply
CO.2	Plot the profile of the earth surface using different leveling methods	Analyze
CO.3	Apply the modern survey equipment to locate the given traverse for various engineering works	Analyze
CO.4	Familiarize in setting out work for plotting of buildings to the site.	Analyze

21UGS533	INTERPERSONAL SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

LIST OF EXPERIMENTS

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6.Speech Master of the Day
7.General Evaluator
8.Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

TOTAL - 30 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Communicate orally with fluency and clarity in a given contextual situation	Responding - Affective Domain
CO.2	Evaluate a speech and offer constructive evaluation of the speech	Evaluating - Cognitive Domain
CO.3	Adapt themselves to work in a group as a member or a leader for efficiently executing the given task	Organization – Affective Domain
CO.4	Analyze a problem and find appropriate solution	Analyze - Cognitive Domain
CO.5	Take decision by organizing relevant information and defining alternatives	Create - Cognitive Domain

VI SEMESTER

21UCE601	CONCRETE TECHNOLOGY (Integrated course)	L	T	P	C
		2	0	3	4

Course Learning Objectives:

- To introduce students to various construction materials, techniques and practices commonly used in civil engineering construction.
- To provide knowledge on the microstructure, admixtures, properties and mix design of concrete.
- To introduce the applications of special concretes and the concreting methods.

Unit I	PRODUCTION OF CONCRETE AND ADMIXTURES	9

Production of concrete, mixing, compaction curing, Quality of water for use in concrete. Chemical admixtures - Accelerators – Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline - Effects on concrete properties.

Unit II	SPECIAL CONCRETES	9

Special concrete; types and specifications – Lightweight concretes - foam concrete- self compacting concrete – vacuum concrete - High strength concrete - Fibre reinforced concrete – Ferro cement - Ready mix concrete – SIFCON - Shot Crete – Polymer concrete - High performance concrete - Geopolymer Concrete.

Unit III	DURABILITY OF CONCRETE	9

Durability – definition and significance. Permeability, sulphate and acid attack, chloride attack and carbonation, Resistance to freezing, , efflorescence, fire resistance- Quality control, Behavior of concrete in extreme environment; temperature problem in concreting, hot weather, cold weather and under water conditions, Inspection and testing of concrete-Concrete cracking, types of cracks, causes and remedies -Deterioration of concrete and its prevention Repair and rehabilitation.(Case studies).

Lab Exercise on Concrete as Practical Component

I. Design of concrete mix as per IS-10262. Tests on fresh concrete:

II. Tests on fresh concrete:

1. Slump Cone
2. Flow Table test
3. Compaction factor
4. Vee Bee test

III. Tests on hardened concrete:

5. Compressive strength test,
6. Split tensile strength test,
7. Flexural strength test

IV. NDT tests

8. Rebound hammer
9. Pulse velocity test

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the Production, Properties, Mix proportion and Durability of Concrete.	Understand
CO.2	Estimate the Quantities of construction materials for concrete mix design.	Apply
CO.3	Determine the mix design and properties of concrete using standard techniques.	Apply
CO.4	Analyze the suitable special concrete and admixtures for different site conditions & requirements.	Analyze
CO.5	Perform the Quality control test on Fresh, Hardened and Durability of Concrete properties.	Evaluate
CO.6	Make use of problem solving approaches to various current issues regarding deterioration of concrete and its prevention techniques and make decisions in teams.	Respond

Text Books:

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2014.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2020.
3. Bhavikatti.S.S, " Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015
4. Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2018.

Reference Books:

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 2000.
2. Gambhir, M.L; "Concrete Technology", 5thEdition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2017
3. Job Thomas, "Concrete Technology", Cengage Learning India Pvt. Ltd., Delhi, 2015
4. Kumar P Mehta., Paulo J M Monterio., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education (India) Private Limited, New Delhi, 2017.

IS Codes: (If necessary for your course)

1. IS code: IS10262-2009 Concrete Mix Design, Bureau of Indian Standards, New Delhi

21UCE602	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	1	0	4

Course Learning Objectives:

- To explore limit state design concepts and design of bolted and welded joints.
- To provide knowledge on design of tension members and compression members.
- To gain knowledge on design of industrial structures.

Unit I	DESIGN OF CONNECTIONS	9+3

Steel Structures – Limit State Design Philosophy – Working Stress Design Philosophy – Review of IS:800 – 1984 and IS 800 - 2007 – Partial Safety factors – Load combinations . Design of Bolted Connections – Welded Connections – Prying action – Eccentric connections – Mini Project (Alternate Assessment).

Unit II	TENSION MEMBERS	9+3

Design of tension members – Calculation of Net Section including lag effects – Staggered Holes and Block Shear – Design of tension splice.

Unit III	COMPRESSION MEMBER	9+3

Buckling Class – Flexural Buckling and Flexural –Torsional Buckling – Effective length factor – Column Formula Design of Compression member – Strut – Stanchion – Column Splicing – Built up Columns – Load comparison of column & Built up column- Lacing and Battening.

Unit IV	FLEXURAL MEMBERS	9+3

Classification of the section: Plastic, Compact, Semi Compact, Slender- Laterally restrained beams – laterally Unrestrained Beams – Lateral Torsional Buckling –Effects of restraints and Effective length- Beam columns.

Unit V	INDUSTRIAL STRUCTURES AND PLATE GIRDERS	9+3

Elements ofroof trusses – Purlins – Loads on trusses – Estimation of Wind Loads on Structures –Design of Gantry Girder – Design of Plate Girder- Applications of Plate girder and purlin.

TOTAL PERIODS:45(L)+15(T) = 60

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the fundamental concepts of steel design such as connections and structural members.	Understand
CO.2	Apply the basic concepts to design the structural steel members for industrial buildings.	Apply
CO.3	Determine the design strength for steel members and check the adequacy for the structural member connections.	Apply
CO.4	Design the standard steel sections using various load combinations to check the safety as per codal Provisions.	Analyze
CO.5	Analyse the behavior of different steel connections and strength characteristics of various structural steel members.	Analyze
CO.6	Design the industrial building components under various loading conditions using Staad pro software.	Analyze

Text Books:

1. Subramanian.N, Design of Steel Structures, Oxford University Press, 2008.
2. Bhavikatti.S.S, Design of Steel Structures By Limit State Method as per IS: 800– 2015,

Reference Books:

1. Purnima B.C Ashok Kumar Join and Arun Kumar Join, “Design of Steel Structures” Laxmi publication Pvt. Ltd, 2015.
2. Duggal S.K “Limit State Design of Steel Structures” McGraw Hill Education (India), 2014.
3. Narayanan.R.et.al. Teaching Resource on Structural Steel Design, Vol.I& II, INSDAG, Ministry of Steel Publications, 2002.
4. NegiL.S.. Design of Steel Structures, Tata McGraw Hill Publishing Pvt Ltd, New Delhi,2007.

IS Codes: (If necessary for your course)

1. IS 800:2015 Indian Standard General Construction in Steel – code of practice, Third Revision.
2. SP 6-1:1964(Reaffirmed 2003) Handbook for Structural Engineers.
3. IS: 875 (Part I) - 1987(Reaffirmed 2003) Code of practice for design loads- Dead loads, Second revision.
4. IS: 875 (Part II) - 1987(Reaffirmed 2003) Code of practice for design loads-Imposed loads, Second revision.

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5. IS: 875 (Part III) - 1987(Reaffirmed 2003) Code of practice for design loads-Imposed loads, Second revision.

6. IS: 875 (Part IV) - 1987(Reaffirmed 2003) Code of practice for design loads-Imposed loads, Second revision.

7. IS: 875 (Part V) - 1987(Reaffirmed 2003) Code of practice for design loads-Imposed loads, Second revision.

21UGS631	LOGICAL REASONING AND APTITUDE (Common to Civil, BT and BME)	L	T	P	C
		1	0	0	1

Objectives:

1. To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
2. To familiarize the student with various principles involved in solving mathematical problems.
3. To develop an understanding of the basic concepts of reasoning skills.

Unit I	QUANTITATIVE APTITUDE	8

Ratio and Proportion - Averages – Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest -– Time – Speed –Distance - Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.

Unit II	VERBAL AND NON VERBAL REASONING	7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation –– Syllogism - Coding – Decoding.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Select an appropriate technique to solve the quantitative problems within the stipulated time.	Apply
CO.2	Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning.	Apply
CO.3	Analyse the direction to solve equations involving one are more unknowns.	Analyse

WEBSITES:

www.m4maths.com, www.indiabix.com, www.fresherworld.com, www.campusgate.co.in, www.indianstudyhub.in, www.tcyonline.com.

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Text Books:
1. Dr. R.S.AGARWAL, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. ABIJIT GUHA, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition, (2013).
Reference Books:
1. ASHISH AGGARWAL, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).
2. Dr.V.A.SATHGURUNATH’S “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011).

21UEC607	PRODUCTDEVELOPMENTPROJECT	L	T	P	C
		0	0	8	4

OBJECTIVE:

Todevelopcompetencywithasetoftoolsandmethodsforproductdesign,manufacturingandmarketingfunctions increatinganewproduct.

Project Description:

Product development is the process of delivering a new product or improving and existing product for customers. This course helps students to convert an idea into a product. Eight periods per week will be allotted in the time table and this time shall be utilized by the students to receive directions from the guide, for library reading, laboratory work, computer analysis and field work as assigned by the guide. There shall be periodical seminar presentations about the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews.

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Design and develop sustainable innovative solutions for societal issues with consideration for public health, safety and environment.	Create
CO.2	Analyze the market potential and evolve the product strategy.	Analyze
CO.3	Apply modern engineering and IT tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice.	Apply
CO.4	Test and evaluate the performance of the developed innovative product using appropriate techniques and tools.	Evaluate
CO.5	Organize effectively as a team for executing the project.	Organise
CO.6	Write effective reports and make clear presentations.	Respond

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21UCE608	HIGHWAYENGINEERINGLABORATORY	L	T	P	C
		0	0	3	1

OBJECTIVE:

- To learn the principles and procedures of testing of highwaymaterials.

EXCERCISES:

I TEST ON AGGREGATES

a) SpecificGravity

b) Los Angeles AbrasionTest

c) Water Absorption ofAggregates

II TEST ONBITUMEN

a) Specific Gravity ofBitumen

b) PenetrationTest

c) ViscosityTest

d) Softening PointTest

e) DuctilityTest

III TESTS ON BITUMINOUSMIXES

a) StrippingTest

b) Determination of BinderContent

c) Marshall Stability and FlowValues

IV DEMONSTRATION OF ANY ONE FIELD TESTING EQUIPMENT LIKE SKID RESISTANCE TESTER/ BENKELMAN BEAMETC

TOTAL: 30 PERIODS

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Possess the ability to use mechanical testing technique and know its applications and limitations.	Understand
CO.2	Interpret the engineering properties of the materials by conducting various test.	Apply
CO.3	Find the properties of the materials based on their gradation by conducting various test.	Apply
CO.4	Assess the Quality of materials by conducting various tests.	Analyze
CO.5	Evaluate the Bitumen Content in the Bituminous Mixes.	Evaluate
CO.6	Make use of problem solving approaches to various current issues regarding deterioration of concrete and its prevention techniques and make decisions in teams.	Evaluate

REFERENCES:

1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition,2009
2. Methods for testing tar and bituminous materials, IS 1201–1978 to IS 1220– 1978, Bureau of IndianStandards
3. Methods of test for aggregates, IS 2386 – 1978, Bureau of IndianStandards
4. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition,1997, Lexington, KY,USA.

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21UGS632	SOFT SKILLS AND COMMUNICATION LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

Unit I	SPEAKING SKILLS	6

Conversational Skills - Self Introduction - Group Discussion - Public Speaking – Presentation Skills

Unit II	WRITING SKILLS	6

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation.

Unit III	READING AND LISTENING SKILLS	6

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking.

Unit IV	SOFTSKILLS	6

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution.

Unit V	INTERVIEW SKILLS	6

Types of Interview – Body Language – Professional Grooming – Basic Etiquette.

TOTAL: 30 (L) = 30 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Students will give oral presentations and improve their reading fluency skills throughextensive reading and listening.	
CO.2	Students will increase their reading speed and comprehension of academic articles byenhancing their vocabulary by keeping a vocabulary journal.	
CO.3	Students will strengthen their ability to write academic papers, essays, officialdocuments and summaries using the process approach.	
CO.4	Students will be aware of correct usage of English grammar and develop in writingskills, speaking fluently and comprehend properly.	

VII SEMESTER

21UME701	PROJECT MANAGEMENT AND FINANCE(Common to All Branches Except CSBS & AGRI)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge to find solutions and approaches for various projects.
- To familiarize the utilization of project within time, resource and financial constraints.

UNIT I	PROJECT MANAGEMENT CONCEPTS	9

Concept and characteristics of a project, importance of project management, types of project, project organizational structure, project life cycle, Statement of Work, Work Breakdown Structure.

UNIT II	PROJECT PLANNING	9

Project Planning and Scheduling techniques - developing the project network using CPM/PERT, Limitations of CPM/PERT, Precedence Diagramming Method, constructing diagram and computations using precedence diagramming method, PERT/CPM simulation, reducing project duration.

UNIT III	RESOURCE SCHEDULING & CRITICAL CHAIN SCHEDULING	9

Resource Scheduling - Resource allocation method, splitting and multitasking, Multi project resources scheduling - Critical Chain Scheduling -Concept of critical chain scheduling - critical chain scheduling method, application of Critical chain scheduling and limitations.

UNIT IV	PROJECT QUALITY MANAGEMENT	9

Concept of project quality, responsibility for quality in projects, quality management at different stages of project, tools and techniques, Quality Management Systems, TQM in projects - Project Performance Measurement and Control - Monitor and assess project performance, schedule, and cost.Earned Value Management, performance measurement methods to monitor, evaluate and control planned cost and schedule performance - Project Closure/ Termination - Meaning of closure/ termination, project audit process, termination steps, final closure.

UNIT V	FINANCIAL ACCOUNTING	9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements. Investments - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

Total: 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the concept and characteristics of project management and application of resource scheduling and critical chain scheduling.	Understand
CO.2	Apply the concept of CPM and PERT to develop the project network.	Apply
CO.3	Estimate the suitable resources required for given project work.	Apply
CO.4	Examine the various tools and techniques at different stages of Quality management.	Analyze
CO.5	Construct the balance sheet to identify the fund flow and cash flow statements.	Apply
CO.6	Evaluate the decision related to forecasting,inventory,quality control problems for industries.	Evaluate

Text Books:

1. Prasanna Chandra, "'Fundamentals of Financial Management' ", Tata Mcgraw-Hill Publishing Ltd, 2015.
2. Jack Meredith, Samuel J.Mantel, "Project Management- A Managerial Approach", John Wiley and Sons

Reference Books:

3. Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process ", Tata Mcgraw-Hill Publishing Co Ltd.
4. John M Nicholas, "Project Management For Business And Technology", Prentice Hall of India Pvt Ltd.
5. Paresh Shah, "Basic Financial Accounting for Management", Oxford University Press, 2020.

21UCE702	ESTIMATING AND COSTING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart the knowledge on basic concepts related to estimate preparation.
- To analyse the rate of a work item according to the specification.
- To identify various items of work in a building & calculate their quantities using appropriate methods.

Unit I	QUANTITY ESTIMATION	9

Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, roads, canals and hydraulic structures using computer softwares.

Unit II	RATE ANALYSIS AND COSTING	9

Standard Data – Observed Data – Schedule of rates – Market rates – Assessment of Man Hours and Machineries for common civil works – Rate Analysis – Cost Estimates using Computer softwares.

Unit III	SPECIFICATIONS, REPORTS AND TENDERS	9

Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads - TTT Act 2000 – Tender notices – types – tender procedures – Drafting model tenders , E-tendering-Digital signature certificates- Encrypting -Decrypting – Reverse auctions.

UNIT IV	CONTRACTS	9

Contract – Types of contracts – Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD / MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements.

UNIT V	VALUATION	9

Definitions – Various types of valuations – Valuation methods – Valuation of land – Buildings – Valuation of plant and machineries - Calculation of Standard rent – Mortgage – Lease.

TOTAL –45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Illustrate the concepts of estimation, costing, Tenders, Contracts and Valuation.	Understand
CO.2	Apply the knowledge of estimation and costing to compute the various rates of work, detailed estimate and standard rent in construction projects.	Apply
CO.3	Estimate the construction materials and labour using computer software.	Apply
CO.4	Analyze the construction of projects with estimation, valuation and tendering.	Analyze
CO.5	Evaluate the item of works, material and rate analysis for various construction projects with a detailed reports	Analyze
CO.6	Plot the drawings and estimate the quantities of various items in building structures using computer software.	Analyze

Text Books:

1. Dutta .B.N, “Estimating and Costing in Civil Engineering Theory and Practice,” UBS Publishers Pvt Ltd., 2019
2. Patil .B.S , “Civil Engineering Contracts and Estimates”, Universities press(India) Pvt. Ltd., 2017.

Reference Books:

1. Birdie .G.S, “A Text Book on Estimating and Costing”, DhanpatRai Co. Pvt. Ltd., New Delhi, 2017.
2. Banerjee.D.N. “J A Parks Principles And Practice of Valuation”, Eastern Law House Private Ltd., New Delhi, 2015
3. Public works department Schedule of rates 2020-21.

21UCE707	STRUCTURAL DESIGN SOFTWARE LABORATORY	L	T	P	C
		0	0	3	1

Course Learning Objectives:

- Enhance the ability to perform modeling, drafting, designing practice and interpretation of results for final design for civil engineering infrastructure.
- To select the suitable software that can perform multi engineering tasks efficiently and satisfy more specific users demands.
- Facilitate the use of spread-sheets to get well verse in design of structural elements and concrete mix design.

LIST OF EXPERIMENTS

I. Design Software 1. Analysis of Flexure Member 2. Analysis of Compression Member 3. Analysis of Plane Truss 4. Seismic Analysis of Two storied 2D Portal frame 5. Seismic Analysis of 3D Portal frame.	**15**
II. Project Management Software 1. Constructing Project: create WBS, Activities, and tasks and Computation Time using Excel spread sheet and transferring the same to Project management software. 2. Constructing Network diagram (AON Diagram) and analyzing for Critical path, Critical activities and other non-Critical paths, Project duration, Floats. 3. Basic understanding about Resource Creation and allocation 4. Understanding about Splitting the activity, Linking multiple activity, assigning Constrains, Merging Multiple projects, Creating Baseline Project.	**10**
III. Microsoft Office Software 1. Design of Singly reinforced rectangular beam. 2. Design of Doubly reinforced rectangular beam. 3. Design of One-way slab. 4. Design of Two way slab. 5. Mix design for various grade of concrete.	**5**

TOTAL – 30 Periods

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COs	CO Statements	BT Levels
CO.1	Use software skills in a professional set up to automate the work and thereby reduce cycle time for completion of the work.	Apply
CO.2	Proficiently use Excel to undertake engineering calculations.	Analyze
CO.3	Select appropriate techniques to solve engineering problems with their limitations.	Evaluate
CO.4	Create the feasibility analysis in Project Management and network analysis tools for cost and time estimation, thereby creating any building project.	Create
CO.5	Analyze the various softwares in construction industries.	Analyze
CO.6	Apply the domain in software areas in quality purpose.	Apply

Reference Books:

1. Krishnamurthy, C.S. and Rajeev, S., "Computer Aided Design and Analytical Tools", Narosa publishers, Second Edition 2018.
2. User Manual.

IS Codes: (If necessary for your course)

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2. IS 10262:2019 Indian Standard Concrete Mix Proportioning – Guidelines, Revised Edition.

LABORATORY EQUIPMENT REQUIREMENTS

Description of Equipment	Quantity
Computer system of Pentium IV or equivalent	1 for Each Student
Licensed version of Standard Analysis and Design software package	Multiple User
Licensed version of Project Management software package	Multiple User

21UCE735	Internship Training	L	T	P	C
		0	0	0	1

Course Learning Objectives:

- Totrainthestudentsinthefieldworksoastohaveafirst-handknowledgeofpracticalproblemsrelated toCivilEngineeringincarryingoutengineeringtasks.
- Todevelop skillsinfacingandsolvingthefield problems..

DESCRIPTION

The students individually undertake training in reputed Civil Engineering Companies during the summer vacation for a specified period of four weeks. At the end of training, a detailed report on the work done should be submitted. The students will be evaluated through a viva-voce examination by a team of internal staff.

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Tackle practicalfield/industryorientatedproblem relatedto CivilEngineering	Apply

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VIII SEMESTER

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21UCE801	PROJECT WORK	L	T	P	C
		0	0	16	8

Course Learning Objectives:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports.
- To prepare the students to face reviews and viva voce examination.

DESCRIPTION

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Design/Develop sustainable solutions for societal issues with environmental considerations applying the basic engineering knowledge.	Create
CO.2	Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion.	Analyze
CO.3	Utilize the new tools, techniques to provide valid conclusion following the norms of engineering practice.	Apply
CO.4	Test and Evaluate the performance of the developed solution using appropriate techniques and tools.	Evaluate
CO.5	Apply management principles to function effectively in the project team for project execution.	Affective Domain
CO.6	Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs.	Affective Domain
CO.7	Write effective reports and make clear presentation to the engineering community and society.	Psychomotor Domain

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ONE CREDIT COURSES

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21UCE861	GREEN BUILDING CONCEPTS	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To understand the necessity of adopting the basic green building concepts.

Introduction to Global Warming - Sources of global warming - Green buildings: Concepts - Rating – Rating by various agencies - Materials used and their Efficiency - Comparison of conventional & green buildings - Environment friendly and cost effective building technologies - Buildings with cost and energy efficient roofing systems - Building in different climatic regions

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply green building concepts in buildings.	Apply

Reference Books:

1. Jerry Yudelson,"The green building revolution", Island press,2010.
2. Abe Kruger and Carl Seville, "Green building: principles and practices in residential construction", Cengage learning,2012.

21UCE862	DESIGN OF SCAFFOLDING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To impart knowledge to plan, prepare and design the scaffolding.

Definition –Requirements and Principles of scaffolding- Types of scaffolding: Standing Scaffolds – Timber Scaffolding –Tube Scaffolding in steel / Aluminium – Scaffolding with Proprietary Equipment –Free standing scaffolds –Suspended Scaffolds - Putlog and Independent scaffold, Single pole scaffolds –Special Scaffolds for tunnel, chimney, open well, oil well, cooling towers, deep foundation, sky scrapper buildings, precast structures, prefabricated structures and composite structure scaffolding – Rigging for Scaffolders - Erection, Alteration and Dismantling – Performance Requirements for Scaffold planks – Design of scaffolding – Maintenance of scaffolding – Formworks.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the types of scaffolding based on requirements	Understand
CO.2	Discuss the various materials used in scaffolding.	Understand
CO.3	Describe the erection process of scaffolding	Remember
CO.4	Describe the concepts of alteration and dismantling of scaffolding	Understand
CO.5	Explain the maintenance of scaffolding	Understand

Textbooks:

1. B.T. Batsford, “Temporary structure design ”, Fb & c Limited 2016.
2. Willey. “scaffolding ”, John villey sons , 2012.

Reference Books:

1. Jimmy W. Hinze, “Construction Safety”, Prentice Hall Inc., 1997.
2. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, “Construction Safety and Health Management”, Prentice Hall Inc., 2001.
3. SP:70, BIS, “Hand Book on Construction Safety Practices”, 2001
4. Rajput.R.K., “Engineering Materials”, S. Chand and Company Ltd., 2008.
   Shetty, M.S, "Concrete Technology, Theory and Practice", Chand Publishing, New Delhi, 2018.

21UCE863	WATER CONSERVATION TECHNIQUES	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To emphasis the importance of ground water conservation

Need of planned utilization of water resources - economics of water resources utilization Water conservation - water harvesting - rainfall- run off relation - water storage in ponds, lakes, reservoirs and aquifers –Types of Pond - selection of pond site – Seepage control - methods-evaporation control-Recycling of harvested water - conservation forestry-water shed management - groundwater recharge through wells - check dams and storage works –. Renovation of water bodies.(Case Study)

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply appropriate rainwater harvesting techniques.	Apply

Reference Books:

1. Santhosh Kumar Garg, Hydrology and water resources engineering, Khanna Publishers,New Delhi. – 2019.
2. G.L.Asawa,Irrigation and Water Resources Engineering ,New Age International (P) Ltd.,Publishers, New Delhi – 2008.

21UCE864	CONSTRUCTION SAFETY	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- The objective of this course is to study various faces of construction safety and cause of major injury.

Safety Management

Construction Safety Management – Role of various parties, duties and responsibilities of topmanagement, site managers, supervisors etc. role of safety officers, responsibilities of general employees,Safety committee, safety training, incentives and monitoring. Writing safety manuals, preparing safety Checklists and inspection reports.

Safety operations AND Safety equipment

Safety in construction operations – Safety of accidents on various construction sites such as buildings,dams, tunnels, bridges, roads, etc. safety at various stages of construction. Prevention of accidents. Safety measures. Safety in use of construction equipment e.g. vehicles, cranes, hoists and lifts etc. safety of scaffolding and working platforms. Safety while using electrical appliances. Explosives used.Various safety equipment and gear used on site. First aid on site, Safety awareness program. Labor laws, legal requirement and cost aspects of accidents on site, Incentive for safety practices. Study of safety policies, methods, equipment, training provided on any ISO approved construction Company ,safety in office, working on sites of high rise construction, deep excavation.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the principles of management and safety procedure in construction	Apply

Text Books:

1. Construction safety manual published by National Safety Commission of India.
2. Safety Management in Construction Industry – A manual for project managers. NICMAR Mumbai.

Reference Books:

1. Construction Safety Handbook – Davies V.S.Thomasin K, Thomas Telford, London.
2. ISI for safety in Construction – Bureau of Indian Standrads.
3. Safety managementll –Girimaldi and Simonds, AITBS, New Delhi.

21UCE865	EFFLUENT TREATMENT PLANT	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To give sound knowledge with understanding of waste water treatment technologies to the students.

Domestic Wastewater Treatment, - Wastewater characteristics; Primary, secondary and tertiary treatment- Physical Unit Processes: Screening; Commutation; Grit Removal; Equalization; Sedimentation - Biological Unit Processes - Aerobic vs. anaerobic processes - Aerobic treatment; Suspended growth aerobic treatment processes; Activated sludge process and its modifications; Attached growth aerobic processes; Tricking filters and Rotating biological contactors - Anaerobic treatment; suspended growth, attached growth, fluidized bed and sludge blanket systems; nitrification, denitrification; Phosphorus removal - Sludge Treatment - Characteristics of sewage sludge- Sludge thickening, sludge digestion, dewatering, drying, Aerobic sludge stabilization- Anaerobic stabilization of sludge and Composting - Water Treatment Plant Characteristics, Plant layout -Operations and maintenance of Treatment plants, Trouble Shooting, - Filtration, Softening of Water, Defluoridation, Removal of Odors -Treated Municipal Wastewater Discharge Systems, Post treatment techniques- - Visit to a municipal wastewater treatment plant and a small plant.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Design and maintain waste water treatment plant based on the characteristics of waste water.	Apply

Reference Books:

1. Garg, S.K., “Environmental Engineering I & II”, Khanna Publishers, New Delhi, 2013.
2. Modi, P.N., “Environmental Engineering I & II”, Standard Book House, Delhi, 2012.
3. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
4. Manual on Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 1993.
5. Hand book on Water Supply and Drainage, SP35, B.I.S., New Delhi, 1987.
6. Metcalf and Eddy, M.C., “Wastewater Engineering – Treatment & Reuse”, Tata McGraw-Hill Publications, New Delhi, 2003.

21UCE866	CORROSION OF STEEL IN CONCRETE AND PREVENTIVE MEASURES	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- The course will provide the students with in-depth knowledge of corrosion and corrosion control techniques.

Corrosion of steel in concrete - Causes and mechanisms of corrosion and corrosion damage in concrete – Carbonation - Chloride attack - Corrosion damage - Vertical cracks and horizontal cracks-Preliminary survey - Detailed survey. - Visual inspection – Delamination – Cover - Half cell potential measurements - Carbonated depth measurement - Chloride determination - Resistivity measurement - Corrosion rate measurement-Basic principles of electrochemical techniques - Cathodic protection - design. Control criteria -System installation - Cathodic protection of prestressed concrete - Cathodic protection of epoxy coated reinforcing steel-Cathodic Protection in Concrete Structures - Laboratory and field studies.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply various types of corrosion control techniques in field	Apply

Reference Books:

1. Corrosion of Steel in Concrete by Broomfield John P. (Taylor & Francis).
2. Corrosion of Steel in Concrete Structures (Wood head Publishing Series in Civil and Structural Engineering) Hardcover – Import, 15 February 2016).

21UCE867	BUILDING PLANNING AND BYELAWS	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To create awareness about building bye laws and development control rules

Objective and principle of planning – Types of building – residential, apartment, commercial, public and industrial – Space standards for buildings – Approval plans and layout preparation and online submission – Field measurement book preparation - General building codes - regulation and Byelaws – Necessity, objects and importance of byelaws – Function of local body authority – Responsibility of building owner – Implementation and applicability of byelaws – Necessity of Setback – Light plane – Plot coverage – Built up area, plinth area, carpet area, Floor space index – Maximum height of buildings and width of street – Off-street parking, Fire protection – Ventilation, lighting, sanitation, rain water harvesting system, STP, compound wall, playground, amenities as per local body authority byelaws – Building Insurance - Real estate Act 2016 - DTCP, CMDA rules.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Prepare the building plans and layouts as per byelaws.	Apply
CO.2	Solve the real estate distributes.	Apply
CO.3	Handle the arbitration issues in buildings.	Evaluate

Reference Books:

1. Sane Y. S., “Planning and Design of buildings”, Malik & May, New Asian Publishers, New Delhi.
2. Tamilnadu Combined Development and building rules-2019.
3. Development Control Rules, CMDA, 2010.
4. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2004.
5. "National Housing Policy", Government of India, 1994.
6. Shah M G., “Building Planning & Drawing”, Tata Mc Graw hill.
7. National Building Code of India 2016, Volume 1&2.
8. Model building byelaws – 2016.

21UCE868	AUTOMATION IN CONSTRUCTION	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To get knowledge about application of automation and use of robots in construction.

Concept and application of Building Management System (BMS) and Automation - art in construction automation- Field sensors actuators, controllers, non-destructive evaluation, data acquisition , examples of sensors in existing automated equipment-Off- site automation in construction Information processing (computer applications), materials processing , case study (concrete batch plant) - Existing and prototype equipment for construction – case study (concrete placement and finishing), final product design session-Automation and robotic technologies for customized component, module and building prefabrication-- Site automation - robotic on site factories.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the application of building management system and automation in on and off site projects.	Understand
CO.2	Solve the construction issues through robotic techniques.	Apply

Textbooks:

1. Javad Majrouhi Sardroud, (2011),"Automated Management of Construction Projects" LAP Lambert Academic Publishing.
2. Wang Shengwei, (2010), "Intelligent Buildings and Building Automation" Taylor & Francis Group.

Reference Books:

1. Majrouhi Sardroud Javad, (2014), "Automation in Construction Management" Scholars' Press.
2. HongleiXu and Xiangyu Wang, (2014), "Optimization and Control Methods in Industrial Engineering and Construction (Intelligent Systems, Control and Automation: Science and Engineering)" Springer

21UCE869	BUILDING ENERGY AUDIT	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To create awareness among students about the importance of energy conservation and the need of energy audit.

Introduction:

Energy scenario-Role of Energy Managers-Energy Monitoring- Energy Audit - Economics of various energy conservation schemes - Total Energy system.

Case studies: Energy conservation in steam systems-Energy conservation in cooling towers &spray ponds-Energy efficiency in lighting.

Energy Efficient Buildings:

Architecture- Building Science and its significance- Human Comfort- Classification of building materials based on energy intensity- Microclimate - Energy Management of Buildings and Energy Audit of Buildings-Energy Efficient Landscape Design.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Analyze various energy conservation schemes.	Analyze
CO.2	Evaluate various case studies on energy conservation and Prepare model to solve issue.	Apply

Textbooks:

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.

Reference Books:

1. SodhaM., Bansal, N.K., Bansal,P.K., Kumar, A.. and Malik, M.A.S.,"Solar Passive Buildings", Pergamon Press, 1986.
2. Koenigsberger, O.H., Ingersoll, T.G., Mayhew Alan and Szokolay, S. V., "Manual of Tropical Housing and Building part 1: Climatic Design", OLBN 0 00212 0011, Orient Longman Limited, 1973.

21UCE870	HEALTH MONITORING OF STRUCTURES	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- The course will provide the students with in-depth knowledge of technologies in structural health monitoring using smart materials as sensing and actuating elements to interrogate the structures. Damage detection techniques such as wave, impedance, and vibration-based damage detection techniques will be discussed and applied to different types of structures.

Introduction and Concepts of SHM- Various Measures-Structural Safety in Alteration- Factors affecting Health of Structures-Causes of Distress-Regular Maintenance-Assessment of Health of Structure-Types of Static Tests-Types of Dynamic Field Test.-piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique- Damage detection techniques -Applications of structural health monitoring in airspace including sandwich composite structures, civil infrastructures, pipelines, rotating machinery- Case Studies (Site Visits).

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Implement fundamental concepts in structural health monitoring, sensors and classify various diagnostic methods of structural health monitoring	Understand / Remember
CO.2	Analyze damage assessment of existing or failure structures	Analyze
CO.3	Select a viable structural health monitoring methodology for a given application based on available technology	Modern tool usage
CO.4	Make an effective communication and presentation as a Individual / team in damage assessment problems	Communication

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus_Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components_Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan,Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc,2007.

21UCE871	ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To impart the students with Artificial Intelligence concept to solve Civil Engineering problems.

Introduction to Artificial Intelligence-Necessities-Development of Artificial intelligence – Potential application of Artificial Neural Network Intelligent- Optimization methods in civil engineering-Genetic algorithms- Application of Artificial Intelligence- Structural Health Monitoring- durability evaluation –Waste management- Concrete Mix Design –Estimation – Neuromodex, Decision making – Modelling initial Design process using ANN-Planning of construction projects- construction Robots – application of GIS –Tidal forecasting- Earthquake Induced liquefaction-Introduction to fuzzy logic – Advantages.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply AI to solve basic and complex Civil Engineering problems.	Apply

Reference Books:

1. ”Artificial Intelligence –A practical approach”, Rajiv Chopra, S CHAND & Company Limited, 2012.
2. “Optimization and Artificial Intelligence in Civil and Structural Engineering” B.H.V.Topping, Springer Science Business Media.

21UCE872	PRACTICAL ASPECTS OF ARCHITECTURE	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To give exposure about architectural principles in the design of buildings.
- To impart knowledge in the national traditions and the local regional heritage in architecture, landscape design including the verna cular tradition.
- To demonstrate competency in the technical, practical skills of landscape architecture and their role in investigating complex and innovative ideas.

Orientation and Planning of Buildings - factors affecting orientation – Sun – Wind – Rain – orientation criteria for Indian conditions – Planning– Specifications and standards-planning of buildings –case studies – Interior Design - Decorative materials – Cement bonded boards, water proof cement – paint - industrial glazing and roofing- masonry - Plaster and dry wall- wall surface materials - effect of colour – Home furnishing – Preparation of interior design plans - case studies- Landscape Design - Principles - Site planning - Design – Styles - Elements and materials - Plant characteristics and design - Landscape planning - case studies.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the architectural principles in the design of buildings and interior spaces.	Understand
CO.2	Make plan for the buildings by considering our Indian climatic conditions.	Apply
CO.3	Choose the various building material as per the interior design aspects.	Evaluate
CO.4	Perform landscape architecture according to the environmental conditions.	Analyze

Reference Books:

1. Francis D.K.Ching, “Architecture: Form, Space and Order”, John Wiley & Sons, Inc. 2007.
2. Mohmohan, MuthuShoba G, “Principles of Architecture” Oxford University Press, New Delhi,2009.
3. Edward D.Mills, “Planning and Architects Handbook”, Butterworth London,1995.
4. Paul Alan Johnson, “The Theory of Architecture: Concepts, Themes & Practices”, John Wiley & Sons, Inc.1994.

21UCE873	APPLICATION OF ROBOTICS IN CIVIL ENGINEERING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To study possible applications of robotics to the various building construction tasks.

Objective and Introduction – Applications-automated systems in construction-Need for robots--ways of Transformations by robotics-Automated technology-Altered workforce-3Dprinting-Demolition-Brick laying-Off-site prefabrication systems, - On-site automated and robotic systems, - Drones and autonomous vehicles-Exoskeletons-Fire proofing spray robot -Steel-beam positioning manipulator-Ceiling-panel-positioning robot Wall-finishing robot -Spray-coating robot- challenges facing automation and robotics in construction.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply the general feasibility of robotic application at the present and future state of building	Apply
CO.2	Procedure for detailed planning and evaluation of robotic application	Evaluate
CO.3	Analyze the feasibility of using robots in building construction.	Analyze

Reference Books:

1. Thomas Bock, Technische Universität München, Thomas Linner, Technische Universität Munchen , Volume 3 , Cambridge University Press,2016.
2. Robotics and Automation in Construction, Carlos Beleaguer, Mohamed Abderrahim,e book- 2008.

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21UCE874	DRONE SURVEYING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

This course will give you the knowledge to start performing drone based surveying; Visual images, maps, and models are the most common deliverables. By utilizing different sensors and capture methods, drones are able to provide useful data to a wide range of industries. This course will show you how to do this and more.

Introduction to Drone Mapping-Types of Drone-Sensors and drone innovation – Potentional uses of drones-Photogrammetry ,Digital Photogrammetry Theory-Photography Principles in Photogrammetric Surveys-Controlling a Survey, Photo Capture- Data Processing-Data Extraction-Data Accuracy, Quality Assurance-Equipment, Planning Your Photogrammetry Survey –Drone regulation- Case Studies.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Identify Drone Mapping and Photogrammetry.	Analyze
CO.2	Evaluate Data Extraction and Data Processing.	Evaluate
CO.3	Apply Technical skills on Topographical and Mapping Surveying.	Apply

Reference Books:

1. Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.
2. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010.
3. Sebbane, Smart Autonomous Aircraft: Flight Control and Planning for UAV. CRC Press, 2015.
4. Zavrsnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance. Springer, 2015.

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21UCE875	RECYCLED CONSTRUCTION MATERIALS	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To provide students an exposure on manufacturing of concrete paver blocks.

Introduction – Types of Recycled Materials – Recycled Aggregates – Ceramic Waste Materials – Rubber Materials – Industrial Waste Materials – Fly ash Materials – E waste Materials – Recycled Plastic Materials – Light Weight Building Materials – Recycled Unfired Clay Bricks materials – Recycled glass Materials – Construction and demolition waste materials – Recycled Concrete Materials – Physical and Chemical Properties of Recycled construction Materials – Salient Features of Materials – Applications of Recycled Materials – Merits and Demerits – Case Studies.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Choose suitable sustainable waste materials used in concrete constructions for the application in field.	Apply
CO.2	Investigate the recycled material characteristics for the real world constructions.	Evaluate

Reference Books:

1. Muller, Recycling Building Materials, Springer Publishing Pvt Ltd, 2021.
2. Ravindra K.Dhir, Sustainable Construction Materials Recycled Aggregates, Woodhead publishing Pvt Ltd, 2019.
3. Alan Richardson, Reuse Materials and Byproducts in Construction, Kindle Edition , Springer Publishing Pvt Ltd, 2013.

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21UCE876	PRACTICAL BUILDING INFORMATION MODELING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To impart knowledge about BIM concept, standards, tools and techniques in the construction industry.

BIM Introduction – BIM uses – BIM dimensions – Understanding an Organization requirement for BIM – Preparing a BIM briefing document to organization – Understanding client requirement – BIM documents for initial stage of the project – Develop an Employer's Information requirement(EIR).

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand a BIM briefing document for client, developing an EIR based on client requirement.	Understand
CO.2	Preparing a Pre and Post contract BIM Execution Plan.	Apply
CO.3	Preparing a Post-Handover report.	Apply
CO.4	Quantity extraction from BIM model using iTWOcostX.	Analyze
CO.5	Detailed Estimate preparation for a BIM model.	Apply

Reference Books:

1. BIM and Construction management – Brad Hardin.
2. Understanding BIM – Jonathan Ingram.
3. iTWOcostX manual – INFINITY PMC SOLUTIONS PVT LTD.

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21UCE877	BUILDING SAFETY	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To understand the operational safety.
- To understand the safety management.

Fire triangle-principles of fire extinguishing- various classes of fires- A, B, C, D types of fire extinguishers- Industrial fire protection systems. Sprinklers- Fire hydrants- Alarm and detection systems- other suppression systems- CO2 system, foam system and DCP system. Incident Recall Technique (IRT), disaster control, Job safety Analysis, Safety survey, safety inspection.Safety training programs, seminars, conferences, competitions- method of promoting safe practice motivation-creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme- domestic safety and training.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Prepare the fire prevention and protection.	Apply
CO.2	Summarize the safety management techniques.	Analyze

TEXT BOOKS:

1. John V. Grimaldi and Rollin H. Simonds, “Safety Management” , All India Travellers Book Seller, New Delhi, 2019.
2. Derek, James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 2016.

Reference Books:

1. Dan Peterson, “Techniques of Safety Management”, McGraw Hill Company, Tokyo, 2016
2. “Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 2015.

21UCE878	BAR BENDING AND DUCTILE DETAILING	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To provide adequate toughness and ductility to resist severe earthquake shocks without collapse.

Bar bending:

Introduction, Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces (IS 13920: 2003), web reinforcement, vertical stirrups and lap splices, ties and hoops, transverse reinforcement for rectangular and circular column, Ductile detailing for flexural members and compression members.

Ductile Detailing:

Introduction, Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces (IS 13920: 2003), web reinforcement, vertical stirrups and lap splices, ties and hoops, transverse reinforcement for rectangular and circular column, Ductile detailing for flexural members and compression members.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Read/Understand routine drawings/sketches and bar bending schedule.	Understand

Reference Books:

1. Bar bending schedules of structural members in civil engineering structures Benjamin N Wobu.
2. IS13920: Ductile Detailing of RC Structures subjected to Seismic Forces.

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21UCE879	GLOBAL CLIMATE CHANGE AND VULNERABILITY ASSESSMENT	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To explain the basic concepts of climate change science.
- To import outline key elements of a vulnerability assessment.

Introduction - the basics of climate change science - climate, weather and the greenhouse gas effect- important greenhouse gases- impacts of climate change on surface temperature, precipitation, ocean pH, sea-level and Arctic sea-ice extent- policy framework to address climate change - highlights ways to measure vulnerability- framework for assessing climate vulnerability. - The political context to greenhouse gas emission-Integrate mitigation-Economic sectors for mitigation actions- elements of national planning for climate finance.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the fundamentals of climate change science.	Understand
CO.2	Analyze different climate change scenarios and their implications.	Analyze
CO.3	Evaluate the key elements of a vulnerability assessment.	Evaluate
CO.4	Analyze main elements of national planning for climate finance.	Analyze

Reference Books:

1. Edmond A. Mathez and Jason E. Smerdon , Climate Change: The Science of Global Warming anOur Energy Future,2018.
2. Andreas Schmittner, Oregan State University,Introduction to Climate Science, https://open.oregonstate.education/climatechange/,2017.

21UCE880	PAVER BLOCK MANUFACTURING AS PER IS CODE	L	T	P	C
		1	0	0	1

Course Learning Objectives:

- To provide students an exposure on manufacturing of concrete paver blocks.

Introduction – Terminologies – Specifications and types of concrete paving blocks – Mix design for concrete blocks pavements – Ingredients of paver blocks – Dimensions – Physical requirements – Mixing Process, Dry and Wet mix process – Making of concrete paver blocks – Curing process - Method of Testing as per IS code – Correction Factor.

TOTAL - 15 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Choose suitable environmental friendly materials for making concrete paver blocks.	Analyze
CO.2	Design and develop the effective concrete paver blocks as per IS standards.	Apply
CO.3	Investigate the strength and durability parameters of paver blocks for the application in Civil Engineering.	Evaluation

TEXT BOOKS:

1. Wasantha Mampearachchi , Handbook on Concrete Block Paving, Springer in nature Singapore Pvt Ltd, 2019.
2. Handbook on advantages of interlocking paver block, Columbia machine Engineering Pvt Ltd, 2019.
3. IS 15658 (2006): Precast concrete blocks for paving - [CED5: Flooring, Wall Finishing and Roofing].
4. M.S.Shetty., “Concrete Technology, Theory & Practice”, S.Chand and Co, New Delhi, 2004.
5. Varghese.P.C, Building Materials, second edition of Prentice Hall India Learning Pvt.Ltd, (2015).

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MANDATORY COURSES

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21UGM131	INDUCTION PROGRAMME	L	T	P	C
		0	3	0	P/F

Course Learning Objectives:

- To rejuvenate the Body and Mind.
- To strengthen Attitude and soft skills.
- To practice Moral values of life.

Unit I	**PHYSICAL ACTIVITY**	**10**
Zumba Bokwa Fitness – Yoga – Mediation – Fine Arts.		
Unit II	**CREATIVE ARTS**	**5**
Painting – Class Painting – Wall Painting – Art from waste.		
Unit III	**UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS**	**5**
Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence– Belief – Morality of life – Guest Lecture by Eminent personality.		
Unit IV	**LITERARY**	**15**
Toastmaster club meet.		
Unit V	**PROFICIENCY MODULES**	**15**
Toastmaster club meet.		
Unit VI	**INDUSTRIAL &LOCAL VISIT**	**8**
Vaigai Dam – Theni - VOC- Port-Tuticorin - Madurai Radio City-Madurai - Aavin Milk –Madurai-NSS Activities.		
Unit VII	**FAMILIARIZATION OF THE DEPARTMENT AND INNOVATION**	**2**
Department Introduction and Purpose of Course - Eminent speakers – Scope and Feature of the Course - Latest Innovation.		

(3 Weeks Model curriculum As per AICTE)Total: 60periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the Practice physical activities regularly, Professional model	Understand
CO.2	Practice physical activities regularly.	Apply
CO.3	Implement creativity in drawing and waste material.	Apply
CO.4	Communicate their ideas effectively.	Evaluation
CO.5	Identify inputs and outputs of different industry process.	Analyze
CO.6	Apply the features of their programme of study.	Apply

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Text Books:
1. AnubhaKaushik, kaushik C.P., “Environmental Science and Engineering”,Third.. Edition, New Age International, New Delhi, 2009.
2. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.
Reference Books:
1. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, Pearson Education Upper saddle River, New Jersey, 2008.
2. Miller T.G. Jr., Environmental Science”, Wadsworth Publishing Company, Belmont, California, 2005.
3. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd., New Delhi,2001.
4. Trivedi R.K., Goel P.K., “Introduction to Air Pollution”, Techno-Science Publication, Jaipur,2005.
5. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

21UGT241	TAMIL AND TECHNOLOGY (Common to ALL Branches)	L	T	P	C
		1	0	0	1

Unit I	WEAVING AND CERAMIC TECHNOLOGY	3

Industries in Sangam Period – Weaving Industry during Sangam Age – Ceramic technology – black and red ware potteries.

Unit II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and construction of Buildings & Construction materials during Sangam Age – Hero stones of Sangam age – Kallanai Dam – Construction on rocks pallava period – Chozha Architecture – Thirumalai Naicker Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Periods.

Unit III	MANUFACTURING TECHNOLOGY	3

Art of ship building – Catamaran – Navy ships – Metallurgical studies – Coins of sangam Era – beads making – industries Stone beads – Glass beads – archeological evidences – Gem stone types described in Silappathikaram.

Unit IV	AGRICULTURE AND ANIMAL HUSBANDRY	3

Agriculture in Sangam period – Land classification – Land ownership – agriculture Technology – Irrigation – Animal Husbandry – Cowherds and shepherds – Cattle rearing – Cattle raiding – Eru Thazhuvuthal – Mattu Pongal – Ponneru Pootuthal – Cattle Shed

Unit V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil – Tamil computing – Tamil computing and Tamil on Internet – Digitalization of Tamil books – Development of Tamil Software – Tamil Virtual Academy – Tamil digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL :15 PERIODS

TEXT-CUM-REFERENCEBOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக. கக. பிள்ளை(வளவியீடு: தமிழ்நாடு பாடநூல் மற்றும்கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ்–முைனவர்இல.சுந்தரம்.(விகடன்பிரசுரம்).
3. கீழடி – ைவைக நதிக்கைரயில் சங்ககால நகர நாகரீகம் (வதால்லியல்துைள வளவியீடு)
4. வபாருைந–ஆற்ளங்கைரநாகரிகம்.(வதால்லியல்துைளவளவியீடு)
5. Social Lifeof Tamils(Dr.K.K.Pillay)Ajointpublication ofTNTB &ESCand RMRL–(inprint)
6. SocialLifeoftheTamils The Classical Period (Dr.S.Singaravelu) (Published by International Institute of Tamil Studies.

21UGM231	ENVIRONMENTAL SCIENCE	L	T	P	C

		3	0	0	P/F

Course Learning Objectives:

- To understand the concepts of Environment and ecosystem.
- To acquire knowledge about the impact of environmental pollution.
- To understand the importance of environmental issues in the society.
- To gain knowledge about the impact of environment related to human health.
- To gain knowledge in alternative energies.

Unit I	**ENVIRONMENTAND ECOSYSTEMS**	**9**

Definition, scope and importance of environment – Need for public awareness – Conceptofecosystem– Structureandfunctionofecosystem–Producers,consumersand decomposers-Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grassland ecosystem.

Unit II	**ENVIRONMENTALPOLLUTION**	**9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution- pollution case studies - Role of an individual in prevention of pollution –Disaster management: floods, earthquake, cyclone and landslides.

Unit III	**SOCIAL ISSUES AND THE ENVIRONMENT**	**9**

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).

Unit IV	**HUMAN POPULATION ANDTHEENVIRONMENT**	**9**

Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights-Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health.

Unit V	**FUTURE POLICYAND ALTERNATIVES**	**9**

Introduction to future policy and alternatives-fossil fuels-nuclear energy-solar energy-wind energy - hydroelectric energy-geothermal energy - tidal energy – sustainability - green power-nanotechnology.

TOTAL –30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concept of structure and function of ecosystem	Understand
CO.2	Apply the knowledge of various pollution types to prevent the ecosystem and Environment	Apply
CO.3	Analyze the environmental problem to report the social issues and the environment.	Analyze
CO.4	Compare the suitable methods for conservation and sustainable development of natural resources	Analyze
CO.5	Apply the principles of value education with respect to human population to preserve environment	Apply
CO.6	Analyze the current energy crisis and suggest suitable sustainable alternatives that promotes social health and environmental prospects.	Analyze

Text Books:

1. AnubhaKaushik, kaushik C.P., “Environmental Science and Engineering”,Third..
2. Edition, New Age International, New Delhi, 2009.
3. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

Reference Books:

1. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’,
2. Pearson Education Upper saddle River, New Jersey, 2008.
3. Miller T.G. Jr., Environmental Science”, Wadsworth Publishing Company, Belmont, California, 2005.
4. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd., New Delhi,2001.
5. Trivedi R.K., Goel P.K., “Introduction to Air Pollution”, Techno-Science Publication, Jaipur,2005.

21UGM331	BIOLOGYFORENGINEERS	L	T	P	C
		3	0	0	P/F

OBJECTIVES:

- Toexplaintheessentialsofbasicbiologicalprinciples.
  Tofamiliarizethedifferentclinicalandindustrialapplicationsof biologyforsolving societal problems with engineering tools.

Unit I	INTRODUCTIONANDCLASSIFICATION	9

Characteristics of living organisms - Basic classification - Cell theory - Structure of prokaryotic andeukaryoticcell –Introduction to Bio-molecules: Definition –General classification and important functions of Carbohydrates –Lipids –Proteins –Nucleic acids, Vitamins and Enzymes - Genes and Chromosome.

Unit II	BIODIVERSITY	9

Plant System: Basic concepts of Plant growth- Nutrition - Photosynthesis and Nitrogen fixation- Animal System: Elementary study of Digestive, Respiratory, Circulatory, Excretory systems andtheirfunctions.

Unit III	BASICSOFCELLANDMOLECULARBIOLOGY	9

DiscoveryofcellandCellTheory–Comparisonbetweenplantandanimalcells–Cellwall– Plasma membrane – Modification of plasma membrane and intracellular junctions – Stem cells andTissueengineering.

Unit IV	HUMANDISEASES	9

InfectiousandNon-infectiousdiseases–Causativeagents–Epidemiology–Pathogenicity, Control and prevention – Treatment of AIDS – Tuberculosis – Pathology of non-infectious and genetic diseases and disorders – Cancer, Diabetes mellitus, Cardiac diseases – Neurological disorders–Parkinson'sdisease.

Unit V	BIOLOGYANDITSINDUSTRIALANDCLINICALAPPLICATIONS	9

Transgenicplantsandanimals–Bioreactors–Bio-pharming–Recombinantvaccines–Cloning – Artificialmemoryandneuralnetworks–Bioremediation–Biofertilizer–Biocontrol–Biofilters Biosensors–Biopolymers–Bioenergy–Biochips.

TOTAL - 30 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explainthefundamentalsoflivingthings,theirclassification,cell structureandbiochemicalconstituents.	(Understand)
CO.2	Applytheconceptof plant,animalandmicrobialsystems andgrowth inreallife situations.	(Apply)
CO.3	Analyzebiologicalengineeringprinciples,proceduresneededtosolve societal issues.	(Analysis)

Text Books:

1. Satyanarayana,U."Biotechnology",4thEdition,BooksandAlliedPvt.Ltd.Kolkata, 2007.
2. CarolD.TamparoandMarciaA."Diseasesof theHumanBody", Lewis, F.A. Davis Company,2011
3. R.Khandpur,"Biomedicalinstrumentation-Technologyandapplications",McGrawHill
4. Professional,2004.

Reference Books:

1. Lehninger A.L, Nelson D.L, Cox .M.M, Principles of Biochemistry", CBS Publications 2017.
2. Arthur T. Johnson, "Biology for Engineers", CRC Press, Taylor and Francis, 2nd Edition, 2019.
3. Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, "Cell Biology and Genetics (Biology: The unity and diversity of life Volume I)", Cengage Learning, 12th Edition,2008.
4. B.D.Singh,"Biotechnology:Expandinghorizon",KalyaniPublishers,2015.

21UGT140	HERITAGEOFTAMIL	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To provide insights regarding the cultural heritage of the Tamil , Sangam Literature and the past History during ancient periods.

UNITI	HERITAGEANDCIVILIZATIONOFTAMILTHROUGH ARCHAEOLOGY				4

Introduction - Basics of archaeology — Historical Source - Archaeological Excavations in Keeladi - Findings based on Keeladi Excavation - Excavations near Mayiladumparai - Excavations near Sivagalai - Excavations atAdichanallur - An Analysis of the excavations in Tamilnadu

UNITII	TAMILHERITAGEINSANGAMAGE				5

Introduction - Sangam Literature - Political History of Sangam Period - Sangam Polity and Administration – Sangam Society - Position of Women during Sangam Age - Economy of the Sangam Age

UNITIII	SOURCESOFANCIENTTAMILHERITAGEAND HISTORY				4

Evidences of Tamilakam in Greek and Roman Literature - Archaeological sources - Evidencefor economic activities - Literary sources in Tamil - Literary Evidences about Tamil History in other languages-Epigraphicalsources-Caveinscriptions-Potteryinscriptions-Numismatic(Coins) sources

UNITIV	EVIDENCEFORANCIENTNESSOFTAMILLITERAURE AND HERITAGE				4

Tamil Literature - India's Earliest Script: Tamili (Tamil Brahmi) - Literary work of AncientTamil - Tolkappiam - Thirukkural & Naladiyar - Tracing Ancient Tamil Literature by U.V. Saminaytha Iyer - Tamil, a Classical Language

Total =15periods

CourseOutcomes

Onsuccessfulcompletionofthiscourse,thestudentswillbeableto:

1. DescribetheHeritageandCivilizationofTamilthroughArchaeology.(Understand)
2. InterprettheTamilLiteratureandCivilizationinhistoricalmanner.(Understand)
3. Demonstratetheabilitytoappreciatetheancientness Tamilheritageandliterature.(Apply) (Valuing —Affective Domain)
4. AnalyzethesourcesofTamilCivilizationrelatingtoIndusValleyCivilization.(Analyze)

TEXT-CUM-REFERENCEBOOKS

7. தமிழக வரலாறு – மக்களும் பண்பாடும் – கக. கக. பிள்ளை(வளவியீடு: தமிழ்நாடு பாடநூல் மற்றும்கல்வியியல் பணிகள் கழகம்).

8. கணினித்தமிழ்–முைனவர்இல.சுந்தரம்.(விகடன்பிரசுரம்).

9. கீழடி -
ைவைகநதிக்கைரயில்சங்ககாலநகரநாகரீகம்(வதால்லியல்துைள வளவியீடு)

10. வபாருைந–ஆற்ளங்கைரநாகரிகம்.(வதால்லியல்துளைவளவியீடு)

11. Social Lifeof Tamils(Dr.K.K.Pillay)Ajointpublication ofTNTB &ESCand RMRL–(inprint)

12. SocialLifeoftheTamils The Classical Period (Dr.S.Singaravelu) (Published by International Institute of Tamil Studies.

13. HistoricalHeritageoftheTamils(Dr.S.V.Subatamanian,Dr.K.D.Thirunavukkarasu)(Publishedby: International Institute of Tamil Studies).

14. TheContributionsoftheTamilstoIndianCulture(Dr.M.Valarmathi)(Publishedby International Institute of Tamil Studies.)

15. Keeladi-'SangamCityCivilizationonthebanksof river Vaigai'(JointlyPublishedby: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)

16. StudiesintheHistoryof IndiawithSpecialReferencetoTamilNadu(Dr.K.K.Pillay) (Publishedby: The Author)

17. PorunaiCivilization(JointlyPublishedby: Departmentof Archaeology&TamilNaduText Bookand Educational Services Corporation, Tamil Nadu).

18. JourneyofCivilization IndustoVaigai(R.Balakrishnan) (Publishedby: RMRL)–Reference Book

தமிழர் மரபு

அலகு 1 தொல்லியல் வழியாக அறியப்படும் தமிழர்களின் மரபும் நாகரீகமும்

அறிமுகம் – தொல்லியலின் அடிப்படைக் கூறுகள் – வரலாற்று தரவுகள் – கீழடி தொல்லியல் அகழ்வராய்ச்சி – கீழடி அகழ்வராய்ச்சியின் கண்டுபிடிப்புகள் – மயிலாடும்பாறை அருகே நடந்த அகழ்வராய்ச்சி - சிவகங்கை அருகே நடந்த அகழ்வராய்ச்சி - தமிழ்நாட்டில் நடைபெற்ற அகழ்வராய்ச்சிகளின் பகுப்பாய்வு

அலகு 2 சங்க கால தமிழர் மரபு

அறிமுகம் – சங்க இலக்கியங்கள் – சங்க கால அரசியல் வரலாறு – சங்க கால அரசியலும் அரசு நிர்வாகமும் – சங்க கால சமூகம் – சங்க கால சமூகத்தில் மகளிரின் நிலை – சங்க கால பொருளாதாரம்

அலகு 3 பண்டைய தமிழர் மரபு மற்றும் வரலாற்றின் ஆதாரங்கள்

கிரேக்க மற்றும் ரோமானிய இலக்கியங்களில் தமிழ்நாடு பற்றிய சான்றுகள்- – தொல்லியல் ஆதாரங்கள் – தமிழ் இலக்கிய ஆதாரங்கள் – தமிழர் வரலாறு பற்றி பிறமொழி இலக்கியங்களில் உள்ள சான்றுகள் - கல்வெட்டு ஆதாரங்கள் – குகை ஓவியங்கள், சிற்பங்களில் உள்ள ஆதாரங்கள் – பண்டைய மண்பாண்ட பொருட்களின் சான்றுகள் – நாணயவியல் ஆதாரங்கள்

அலகு 4 பண்டைய தமிழர் இலக்கியம் மற்றும் மரபின் தொன்மைக்கான ஆதாரங்கள்

தமிழ் இலக்கியங்கள் – இந்தியாவின் மிக ஆரம்பகால எழுத்து வடிவம் – (தமிழ் பிராமி எழுத்து வடிவம்) – பண்டைய தமிழகத்தின் இலக்கியப் பணிகள் – தொல்காப்பியம் – திருக்குறள் மற்றும் நாலடியார் – தொன்மை தமிழ் இலக்கியங்களை தடமறிந்து கண்டடைந்த உ வே சாமிநாத ஐயர் – தமிழ் – ஒரு உயர்தனிச் செம்மொழி

21UGM431	GENDER EQUALITY	L	T	P	C
		1	0	0	P/F

Course Learning Objectives:

- To introduce basic concepts relating to gender and to provide logical understanding of gender roles.

Unit I	GENDER SENSITIZATION	10

Definition of gender, Perspectives-Gender sensitive approach- Gender and sex- Social construction of gender and gender roles- Socialisation- institutions of socialization- changing content and context of gender-need for re-socialization. Gender Stereotyping and Gender Discrimination.

Unit II	GENDER EQUALITY AND CONSTITUTION	10

Indian constitution related to equality - Fundamental rights - Directive principles of state policy - right to equality - rights against exploitation - cultural and educational rights - the right to constitutional remedy - University Declaration of Human Rights - Enforcement of Human Rights for Women and Children - Role of Cells and CounsellingCentres- Internal Complaints Committee - Legal AID cells, Help line, State and National level Commission.

Unit III	GENDER ROLES & EQUALITY	10

Gender & Morality – Structural and functionalist views of Gender- Gender in the Classroom- Beyond access for girls and boys- Gender equality in schools- Gender equality and adult basic education- Developing capacity to achieve gender equality in education- Individuality and removal of gender stereotypes- Respect for each other's-Promote equal Opportunity.

TOTAL: 30 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the social construction of gender and sexuality and their influence in social context.	Understand
CO.2	Analyze how the concepts of gender equality are created, maintained, and/or challenged.	Analyze
CO.3	Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project.	Apply

Text Books:

1. Sheila Aikman and Elaine Unterhalter, "Practising Gender Equality in Education", Oxfam GB, 2007.
2. Pasadena and Hackensack, "Gender roles and Equality", Salem Press 2011.

21UGT140	HERITAGEOFTAMIL	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To provide insights regarding the cultural heritage of the Tamil , Sangam Literature and the past History during ancient periods.

UNITI	HERITAGEANDCIVILIZATIONOFTAMILTHROUGH ARCHAEOLOGY	4

Introduction - Basics of archaeology — Historical Source - Archaeological Excavations in Keeladi - Findings based on Keeladi Excavation - Excavations near Mayiladumparai - Excavations near Sivagalai - Excavations atAdichanallur - An Analysis of the excavations in Tamilnadu

UNITII	TAMILHERITAGEINSANGAMAGE	5

Introduction - Sangam Literature - Political History of Sangam Period - Sangam Polity and Administration – Sangam Society - Position of Women during Sangam Age - Economy of the Sangam Age

UNITIII	SOURCESOFANCIENTTAMILHERITAGEAND HISTORY	4

Evidences of Tamilakam in Greek and Roman Literature - Archaeological sources - Evidencefor economic activities - Literary sources in Tamil - Literary Evidences about Tamil History in other languages-Epigraphicalsources-Caveinscriptions-Potteryinscriptions-Numismatic(Coins) sources

UNITIV	EVIDENCEFORANCIENTNESSOFTAMILLITERAURE AND HERITAGE	4

Tamil Literature - India's Earliest Script: Tamili (Tamil Brahmi) - Literary work of AncientTamil - Tolkappiam - Thirukkural & Naladiyar - Tracing Ancient Tamil Literature by U.V. Saminaytha Iyer - Tamil, a Classical Language

Total =15periods

CourseOutcomes

Onsuccessfulcompletionofthiscourse,thestudentswillbeableto:

COs	CO Statements	BT Levels
CO.1	DescribetheHeritageandCivilizationofTamilthroughArchaeology.	Understand
CO.2	InterprettheTamilLiteratureandCivilizationinhistoricalmanner	Understand
CO.3	DemonstratetheabilitytoappreciatetheancientnessTamilheritageandliterature.	Apply(Valuing — Affective Domain)
CO.4	AnalyzethesourcesofTamilCivilizationrelatingtoIndusValleyCivilization.	Analyze

TEXT-CUM-REFERENCEBOOKS

19. தமிழகவரலாறு– மக்களும்பண்பாடும்– கக. கக. பிள்ளை(வளவியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
20. கணினித்தமிழ்–முனைவர்இல.சுந்தரம்.(விகடன்பிரசுரம்).
21. கீழடி–வைகை நதிக்கைரயில் சங்ககால நகர நாகரீகம் (வதால்லியல்துளைவளவியீடு)
22. வபாருைந–ஆற்ளங்கைரநாகரிகம்.(வதால்லியல்துளைவளவியீடு)
23. Social Lifeof Tamils(Dr.K.K.Pillay)Ajointpublication ofTNTB &ESCand RMRL– (inprint)
24. SocialLifeoftheTamils - TheClassicalPeriod(Dr.S.Singaravelu)(PublishedbyInternationalInstitute of Tamil Studies.
25. HistoricalHeritageoftheTamils(Dr.S.V.Subatamanian,Dr.K.D.Thirunavukkarasu)(Publishedby: International Institute of Tamil Studies).
26. TheContributionsoftheTamilstoIndianCulture(Dr.M.Valarmathi)(PublishedbyInternational Institute of Tamil Studies.)
27. Keeladi-'SangamCityCivilizationonthebanksof river Vaigai'(JointlyPublishedby: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
28. StudiesintheHistoryof IndiawithSpecialReferencetoTamilNadu(Dr.K.K.Pillay) (Publishedby: The Author)
29. PorunaiCivilization(JointlyPublishedby: Departmentof Archaeology&TamilNaduText Bookand Educational Services Corporation, Tamil Nadu).
30. JourneyofCivilization IndustoVaigai(R.Balakrishnan) (Publishedby: RMRL)– Reference Book

தமிழர் மரபு

அலகு 1 தொல்லியல் வழியாக அறியப்படும் தமிழர்களின் மரபும் நாகரீகமும்

அறிமுகம் – தொல்லியலின் அடிப்படைக் கூறுகள் – வரலாற்று தரவுகள் – கீழடி தொல்லியல் அகழ்வராய்ச்சி – கீழடி அகழ்வராய்ச்சியின் கண்டுபிடிப்புகள் – மயிலாடும்பாறை அருகே நடந்த அகழ்வராய்ச்சி - சிவகங்கை அருகே நடந்த அகழ்வராய்ச்சி - தமிழ்நாட்டில் நடைபெற்ற அகழ்வராய்ச்சிகளின் பகுப்பாய்வு

அலகு 2 சங்க கால தமிழர் மரபு

அறிமுகம் – சங்க இலக்கியங்கள் – சங்க கால அரசியல் வரலாறு – சங்க கால அரசியலும் அரசு நிர்வாகமும் – சங்க கால சமூகம் – சங்க கால சமூகத்தில் மகளிரின் நிலை – சங்க கால பொருளாதாரம்

அலகு 3 பண்டைய தமிழர் மரபு மற்றும் வரலாற்றின் ஆதாரங்கள்

கிரேக்க மற்றும் ரோமானிய இலக்கியங்களில் தமிழ்நாடு பற்றிய சான்றுகள்- – தொல்லியல் ஆதாரங்கள் – தமிழ் இலக்கிய ஆதாரங்கள் – தமிழர் வரலாறு பற்றி பிறமொழி இலக்கியங்களில் உள்ள சான்றுகள் - கல்வெட்டு ஆதாரங்கள் – குகை ஓவியங்கள், சிற்பங்களில் உள்ள ஆதாரங்கள் – பண்டைய மண்பாண்ட பொருட்களின் சான்றுகள் – நாணயவியல் ஆதாரங்கள்

அலகு 4 பண்டைய தமிழர் இலக்கியம் மற்றும் மரபின் தொன்மைக்கான ஆதாரங்கள்

தமிழ் இலக்கியங்கள் – இந்தியாவின் மிக ஆரம்பகால எழுத்து வடிவம் – (தமிழ் பிராமி எழுத்து வடிவம்) – பண்டைய தமிழகத்தின் இலக்கியப் பணிகள் – தொல்காப்பியம் – திருக்குறள் மற்றும் நாலடியார் – தொன்மை தமிழ் இலக்கியங்களை தடமறிந்து கண்டடைந்த உ வே சாமிநாத ஐயர் – தமிழ் – ஒரு உயர்தனிச் செம்மொழி

21UGM631	INDIAN CONSTITUTION (Common to All Branches)	L	T	P	C
		1	0	0	1

COURSEOBJECTIVE:

- Thestudentswillbeexposedtofundamentalrights&dutiesinIndian Constitution.
- Thestudentswillbegivenknowledgeonthecomponentsoftheparliamentarysystemto prepare for the process of their career development.
- The student will have knowledge on powers andfunctions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB…
- Thestudentwillknowaboutthe functionsofjudiciaryandelectoralprocessfollowedinthe country.

Unit I	INTRODUCTIONONINDIANCONSTITUTION	

Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articlesofconstitution-importantAmendmentsofconstitution.

Unit II	PARLIAMENTARYSYSTEM	

Parliamentary System —parliamentary system of other countries - Indian parliamentary system- Federal System —LS and RS,Centre-State Relations-Election of member of parliaments- Union Executive-President,PrimeMinister,UnionCabinet.StateLegislature -StateExecutives–election ofMLA-Governor,ChiefMinister,StateCabinet.

Unit III	JUDICIARYANDELECTIONCOMMISSION	

Supreme Court of India: Structure, Power and Functions of Supreme Court-- Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. — Lokadhalats.Elections-ElectoralProcess-ElectionCommissionofIndia-ElectionLaws — EmergencyProvisions-typesofEmergenciesanditsconsequences.

Unit IV	LOCALADMINISTRATION	9

LocalAdministration:PowersandfunctionsofMunicipalitiesandPanchayatsSystem-Panchayat Raj- Co–operative Societies and Constitutional and Non-constitutional Bodies.

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the ethical responsibilities of municipalities, panchayats and co-operative societies.	Understand
CO.2	Manage complex societal issues in society with the knowledge of judiciary and local administration.	Analyze
CO.3	Interpret the societal, health, safety, legal and cultural issueswith understanding ofparliamentary system and electoral process through self-learning skills.	Evaluate
CO.4	ApplyknowledgeofthefundamentalrightsanddutiesprescribedbyIndian Constitution to prepare for various competitive examinations.	Apply
CO.5	Analyzethefunctioningoftheparliamentarysystemfollowedin various countries.	Analyze
CO.6	ApplyknowledgeofthefundamentalrightsanddutiesprescribedbyIndian Constitution to prepare for various competitive examinations.	Apply

Text Books:

1. Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” byCengage Learning India Private Limited, 2018.
2. Subhash C. Kashyap,”Our Constitution: An Introduction to India’s Constitution and constitutional Law”, NBT, 2018.
3. Brij Kishore Sharma,“Introduction to the Constitution of India”, PHI Learning Pvt. Ltd., New Delhi, 2011
4. M.V.Pylee, “An Introduction to Constitution of India”, Vikas Publishing, 2002.
5. Durga Das Basu, “Introduction to the Constitution on India”,Prentice Hall, 2001.

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21UGM731	SPORTS AND SOCIAL DEVELOPMENT (COMMON ALL BRANCHES)	L	T	P	C
		-	-	-	P/F

Course Learning Objectives:

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others

Unit I	HUMAN VALUES	7

Morals- Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage - Valuing Time - Co-operation –Commitment – Empathy- self-Confidence –Character

Unit II	ENGINEERING ETHICS	7

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues –Uses of Ethical Theories.

Unit III	UNIVERSAL HARMONY	4

Engineering Harmony in the family – Harmony in the society – Trust and Respect – Universal harmonious order

Unit IV	SAFETY, RESPONSIBILITIES AND RIGHTS	6

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V	GLOBAL ISSUES	6

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL : 30 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.	

Text Books:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

21UGM831	PROFESSIONALETHICS&HUMANVALUES(CommontoAll Branches)	L	T	P	C
		2	0	0	P/F

OBJECTIVES:

- ToenablethestudentstocreateanawarenessonEngineeringEthicsandHuman ValuestoinstillMoralandSocialValuesandLoyaltyandtoappreciatetherightsof others.

UNITI	HUMANVALUES	7

Morals-ValuesandEthics–Integrity–WorkEthic–ServiceLearning–CivicVirtue–Respect forOthers—LivingPeacefully—caring—Sharing—Honesty—Courage-ValuingTime-Co- operation –Commitment – Empathy- self-Confidence –Character.

UNITII	ENGINEERINGETHICS	7

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – MoralAutonomy —Kohlberg's theory —Gilligan's theory —Consensus and Controversy — Professions and Professionalism – Professional Ideals and Virtues –Uses of Ethical Theories.

UNITIII	ENGINEERINGASSOCIALEXPERIMENTATION	4

EngineeringHarmonyinthefamily–Harmonyinthesociety–TrustandRespect–Universal harmoniousorder

UNITIV	SAFETY,RESPONSIBILITIESANDRIGHTS	6

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority —Collective Bargaining —Confidentiality —Conflicts of Interest — OccupationalCrime–ProfessionalRights–EmployeeRights–IntellectualPropertyRights (IPR)—Discrimination.

UNITV	GLOBALISSUES	6

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development– Engineers as Managers – Consulting Engineers – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL:30PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.	

Text Books:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

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VERTICALS

(PROFESSIONAL ELECTIVE COURSES)

21CEV101	DESIGN OF CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To acquire hands on experience in design and preparation of structural drawings for concrete structures.
- To give an exposure on the behaviour, analysis and design of R.C. structures.
- To teach the design & detailing aspects of RC structures using software.
- To encountered in Civil Engineering practice using Computer Software Staad Pro, E-Tabs and any Structural design and analysis Software.

Unit I	INTRODUCTION AND CODES	9

Geometric Parameters, Grade of concrete and steel for different elements, Exposure and cover requirements, Fire rating, Load Combinations, Serviceability Requirements, Analysis tools. Indian & International Codes for Reinforced concrete Design, Design loads, National Building Code 2016, Practical building example, drawing sizes and scale.

Unit II	LOADS ACTING ON STRUCTURES	9

Introduction, Dead, Live loads, Wind loading and Calculations of - force coefficients, Wind pressure, storey forces and base shears. Earthquake loading and Calculations of - acceleration coefficient, Time period, Base shear. Scheme Design, Concrete floor systems, Sizing and design of various slab systems, Beams, Reinforced Concrete Columns - Location and Shape, Design Axial Load, sizing, Lateral Load Systems, IS 1893- Requirements.

Unit III	MODELLING OF BASIC STRUCTURAL ELEMENTS	9

Introduction to Analysis & Modelling, Modelling of Cantilever, Portal Frame, three bay Portal Frame, 3D structural models - Geometry, gravity loads, defining earthquake loads, defining wind loads, Modelling Shear walls, Practical Structural Model of building, Structural models of Floor System, Estimation of deflections.

Unit IV	DESIGN OF STRUCTURAL ELEMENTS	9

Design of Beams- flexural reinforcement, shear reinforcement, Design of flat slabs- Flexural Reinforcement, shear reinforcement, Design of 2-way continuous slabs. Design of Reinforcements in Columns, Post processing, Design and arrangement of vertical reinforcement, horizontal reinforcement in the design of buildings. Design of shear walls - Sizing of elements based on Constructability aspects like formwork, concrete placement and compaction, rebar arrangement to satisfy economy and optimum utilization.

Unit V	DETAILING OF STRUCTURAL ELEMENTS	9

Development of Reinforcement, Typical details of- flat slabs, two-way continuous slabs, beams, columns and shear wall, detailing and documentation. Case Studies : Structural analysis and design of a multi-storey building with load calculation (dead, live, wind and seismic) as per Indian standard codes using any Structural design and analysis Software.

Total: 45periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the basic design fundamentals of RC structures and its components.	Understand
CO.2	Apply the engineering knowledge to compute the geometric parameters for various concrete structures.	Apply
CO.3	Apply the basic concept to determine the loads using IS codes and various computational tools.	Apply
CO.4	Analyse the structure for various loads and load combination according to the relevant IS codes.	Analyze
CO.5	Design and Analysis of structures using computer software/tools.	Design
CO.6	Prepare the complete structural drawings using computer software.	Apply/Modern tool Usage

Text Books:

1. Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2009.
2. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.

Reference Books:

1. Krishnaraju.N “ Design of Reinforced Concrete Structures “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
2. Sinha, S.N., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.
3. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt. Ltd., New Delhi, 2007.

IS Codes: (If necessary for your course)

1. IS:456-2000 - Indian Standard Code of Practice for Plain and Reinforced Concrete.
2. SP16-Design Aid for RC to IS 456-1978.
3. IS:13920-1993 - Ductile detailing of reinforced concrete structures subjected to seismic

R21CEV102	MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide knowledge on various materials used in the masonry structures.
- To provide knowledge on behavior of masonry in compression and effect of masonry unit height on compressive strength.
- To develop an understanding on the basic concepts in the behavior and design of masonry structures under flexural and shear strength.
- To explain the basic concepts in the design of load bearing masonry structures.
- To explain the behavior of masonry structures during earthquakes.

Unit I	INTRODUCTION	9

Introduction, Masonry units, materials and types: History of masonry, Characteristics of Brick, stone, clay block, concrete block, stabilized mud block masonry units. Strength, modulus of elasticity and water absorption. Masonry materials – Classification, properties of mortars & Selection of mortars.

Unit II	STRENGTH OF MASONRY IN CONSTRUCTION	9

Behavior of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, failure theories of masonry under compression. Effects of slenderness and eccentricity, effect of rate of absorption, effect of curing, effect of ageing, workmanship on compressive strength.

Unit III	FLEXURAL AND SHEAR BOND	9

flexural strength and shear strength: Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength, orthotropic strength properties of masonry in flexure, shear strength of masonry, test procedures for evaluating flexural and shear strength. Permissible stresses: Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses.

Unit IV	DESIGN OF LOAD BEARING MASONRY BUILDINGS	9

Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall.

Unit V	EARTHQUAKE RESISTANT MASONRY BUILDINGS	9

Behavior of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions, Masonry arches, domes and vaults: Components and classification of masonry arches,

domes and vaults, historical buildings, construction procedure

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the flexural and shear strength of the masonry walls.	Understand
CO.2	Analyze the behavior of masonry in compression and failure theories in masonry walls.	Analyze
CO.3	Design a masonry wall subjected to various loading and boundary conditions as per codal provisions.	Evaluate
CO.4	Identify and solve masonry structural system subjected to gravity, wind and seismic loadings.	Evaluate
CO.5	Analyze the behavior of masonry in compression and failure theories in masonry walls.	Analyze
CO.6	Application models for the behaviour of structural elements	Apply

Text Books:

1. Dayaratnam P, “Brick and Reinforced Brick Structures”- Oxford & IBH.
2. Sinha B.P & Davis S.R., “Design of Masonry structures”- C R C press.

Reference Books:

1. Hendry A.W., “Structural masonry”- Macmillan Educaon Ltd., 2nd edition.
2. Curtin, “Design of Reinforced and Pre-stressed Masonry”- Thomas Telford.
3. Sven Sahlin, “Structural Masonry”-Prentice Hall.
4. Jagadish K S, Venkatarama Reddy B V and Nanjunda Rao K S, “Alternative Building MaterialsandTechnologies”-New Age International, New Delhi & Bangalore.
5. IS 1905, BIS, New Delhi.
6. SP20(S&T), New Delhi.

21CEV103	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the basic principles of prefabrication.
- To be thorough with the calculation of handling and erection stresses.
- To know about dimensioning and detailing of joint.
- To acquire knowledge on erection of structures.
- To get familiar with the design principles of prefabricated units.

Unit I	INTRODUCTION	9

Modular co-ordination – Standardization - Components - Prefabrication systems and structural schemes - Types of foundation - Design considerations - Economy of prefabrication - Prefabrication of load-carrying members - Disuniting of structures - Structural Behaviour of precast structures.

Unit II	HANDLING STRESSES AND ERECTION STRESSES	9

Handling stresses and erection stresses - Application of pre stressing of roof members – Floor systems - Two way load bearing slabs - Wall panels - Shear walls.

Unit III	DIMENSIONING AND DETAILING OF JOINTS	9

Dimensioning and detailing of joints for different structural connections – Construction joints and expansion joints - Allowance for joint deformation.

Unit IV	ERECTION OF STRUCTURES	9

Production - Transportation and Erection - Organizing of production – Storing -and erection equipment - Shuttering and mould design - Dimensional tolerances, Erection of R.C. structures –Total Fully prefabricated buildings.

Unit V	DESIGN OF PRE FABRICATED UNITS	9

Design considerations - Code provisions -Progressive collapse – Prefabricated units for Industrial structures, Multi-storied buildings and Water tanks etc., Application of pre stressed concrete in prefabrication..

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Attain the knowledge about the process of manufacturing, transportation and erection of the prefabricated components.	Understand
CO.2	Implement the applications of various components of prefabricated structures.	Apply
CO.3	Analyse various components of the prefabricated structure to ensure the limitations.	Analyze
CO.4	Diagnose the problems occur while designing the prefabricated components.	Analyze
CO.5	Estimate the load calculations and dimensions of the prefabricated members while designing.	Evaluate
CO.6	Assemble the individually made members to form a complete prefabricated structure.	Create

Text Books:

1. Hubert Bachmann, Alfred Steinle, “Precast Concrete Structures”, Ernst and Sohn GMBH & Co., K.G.,2011.
2. "Structural design manual", Precast concrete connection details, Society for the studies inthe use of precast concrete, Netherland BetorVerlag, 2009.
3. Gerostiza C.Z., Hendrikson C. and Rehat D.R.," Knowledge based process planning for construction and manufacturing", Academic Press Inc., 1994.

Reference Books:

1. B.Lewicki, “Building with Large Prefabricates”, Elsevier Publishing Company, Amsterdam / London / New York, 1966.
2. Levit, M., (2000), Precast concrete materials, Manufacture properties and usage, Applied Science Publishers, London.
3. Kim S. Elliott, “Precast Concrete Structures” Butter – Heinemann, 2002.
4. LassloMokk, “Prefabricated Concrete for Industrial and Public Sectors, AkademiaiKiado”, Budapest,1964.
5. KonczT.,"Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH,1976.

21CEV104	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the methods and types of prestressing and to enable the students to design prestressed concrete structural elements and systems.

Unit I	INTRODUCTION – THEORY AND BEHAVIOUR	9

Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Mangle, Lee-McCall and Gifford Udall anchorage systems – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Losses of prestress in post -tensioned and pre-tensioned members.

Unit II	DESIGN FOR FLEXURE AND SHEAR	9

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

Unit III	DEFLECTION AND DESIGN OF ANCHORAGE ZONE	9

Factors influencing deflections – Short-term deflections of uncracked members – Prediction of long-term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and I.S. 1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams– design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

Unit IV	COMPOSITE BEAMS AND CONTINUOUS BEAMS	9

Analysis and design of composite beams – Shrinkage strain and its importance – Differential shrinkage - Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

Unit V	MISCELANEOUS STRUCTURES	9

Role of prestressing in members subjected to Tensile forces and compressive forces – Design of Tension members and Compression members - Design of Tanks, Pipes, Sleepers and Poles – Partial prestressing – methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Specify and characterize the materials required for prestressed concrete structures.	Understand
CO.2	Calculate losses and deflection in various prestressed members.	Apply
CO.3	Design end block reinforcement, concrete tanks and pipe for PSC members.	Apply
CO.4	Analyze the stresses encountered in PSC element during transfer and at working.	Analyze
CO.5	Analyze prestressed concrete members for flexure and their flexural strength.	Analyze
CO.6	Justify how the end blocks of prestressed concrete beams are strengthened against bursting tension.	Evaluate

Text Books:

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012
2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014

Reference Books:

1. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt.Ltd., New Delhi, 2013.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2017.
3. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2017.
4. Sinha.N.C. And Roy.S.K. Fundamentals of Prestressed Concrete, S.Chand and Co. Ltd., 2011.

IS Codes: (If necessary for your course)

1. S1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, Second revision.
2. S: 784 - 2001 - IS Specification for Prestressed Concrete Pipes.IS: 6006-1983 Uncoated Stress relieved Strand for Prestressed concrete.

21CEV105	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

Unit I	MAINTENANCE AND REPAIR STRATIGES	9

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration..

Unit II	STRENGTH AND DURABILITY OF CONCRETE	9

Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion.

Unit III	SPECIAL CONCRETES	9

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete- High performance concrete - Self compacting concrete - Geopolymer concrete - Concrete made with industrial wastes.

Unit IV	TESTING TECHNIQUES AND PROTECTION METHODS	9

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

Unit V	STRENGTHENING, REPAIR, REHABILITATION AND RESTORATION OF STRUCTURES	9

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies on Maintenance and rehabilitation of steel structures, pavements, and masonry structures.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Know the importance of inspection and maintenance.	Understand
CO.2	Analyze the various Impacts of cracks, corrosion and climate on structures.	Analyze
CO.3	Analyze the various special concretes in construction.	Analyze
CO.4	Interpret the various testing techniques and various protection measures.	Apply
CO.5	Know the Repair of structures and Restoration of Heritage structures.	Apply
CO.6	Identify the various repair techniques due to corrosion.	Apply

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Text Books:
1.Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, EighthEdition, 2019.
2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.
Reference Books:
1.P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.
2.Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 2012.

21CEV106	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the behaviour of structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions.

Unit I	INTRODUCTION TO DYNAMICS	9

Dynamics - Degree of freedom – Free and forced vibration - Idealization of structure as Single Degree of Freedom (SDOF) and Multi degree of freedom (MDOF) system – D'Alemberts Principles - Formulation of equation of motion for SDOF system and MDOF system –- Evaluation of natural frequencies and modes - Effect of damping.

Unit II	SEISMOLOGY	9

Elements of Engineering Seismology – Seismic hazard - Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction – Liquefaction of soil - Seismic zone map – Response spectra.

Unit III	EARTHQUAKE EFFECTS ON STRUCTURES	9

Inertia force on structures – load transfer path – Effect of architectural features on behavior of structures – Hysteretic Behaviour of RCC, steel and prestressed concrete - Pinching Effect – Bouchinger Effects - Energy dissipation - P-delta effect - storey drift - Behavior of brick masonry, stone masonry and reinforced concrete structures under past earthquakes – typical failures - Causes of damage –- Lessons learnt from past earthquakes.

Unit IV	EARTHQUAKE LOAD ANALYSIS	9

Design spectra – Codal provision – Different methods of earthquake analysis –- Analysis of structure by Equivalent static method – Analysis of structure by Response spectrum method – Introduction to time-history method of analysis.

Unit V	EARTHQUAKE RESISTANT DESIGN	9

Philosophy of earthquake resistant design - Planning considerations and Architectural concepts - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member, Ductile detailing of beam-column joints and footing – Concept and principle of shear wall - Introduction to performance based seismic design - Seismic isolation principles and methods.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the basic principles of the Degree of Freedom system and develop the equation of motion for the MDOF system and earthquake parameters.	Understand
CO.2	Calculate the free and forced vibration characteristics of SDOF systems.	Apply
CO.3	Apply BIS codes for earthquake resistant design and detailing of R.C.C. and masonry buildings.	Apply
CO.4	Evaluate seismic response of simple structures using response spectra method.	Evaluate
CO.5	Design earthquake resistant building structures.	Apply
CO.6	Create a model of seismic structures using mathematical and engineering sciences.	Apply

Text Books:

1. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.

Reference Books:

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.
3. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007.

IS Codes: (If necessary for your course)

1. IS 4326: 2013 Earthquake Resistant Design And Construction Of Buildings – Code of Practice.
2. IS 1893: 2016 Criteria For Earthquake Resistant Design Of Structures – Part 1 General Provisions and Buildings.
3. IS 13920:2016 Ductile Design And Detailing Of Reinforced Concrete Structures Subjected to SeismicForces – Code of Practice.

21CEV107	FINITE ELEMENT METHODS (Integrated course)	L	T	P	C
		2	0	2	3

Course Learning Objectives:

- To impart the concepts of finite element methods.
- To impart knowledge in the analysis of frame structures.
- To train the students in the analysis of beams and 2D,3D Frame structures using Finite element software.

Unit I	INTRODUCTION TO FINITE ELEMENT METHOD	9+6

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity - Steps in Finite Element Analysis - Virtual Work and Variational Principle -Rayleigh-Ritz method- Galerkin Method- simple application in structural analysis.

Unit II	ELEMENT PROPERTIES	9+6

Natural Coordinates - Triangular Elements - Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements -Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two Dimensional and Three Dimensional.

Unit III	ANALYSIS OF FRAME STRUCTURES	9+6

Stiffness of Truss Members - Analysis of Truss - Stiffness of Beam Members - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Analysis of Grid and Space Frame-Finite Element Formulation for 3 Dimensional Elements – Solution for simple frames.- Introduction to Plate Bending Problems.

LIST OF EXPERIMENTS

Analyze and Design Exercises for practical component (Using computer software)

1. Use of FEM packages for analysis of propped cantilever, fixed beams, continuous beam.
2. Use of FEM packages for analysis of pin jointed frame,2D rigid frame.
3. Use of FEM packages for analysis of 3D rigid and pin jointed frame and Multistory & multi bay Frame structures.
4. Thermal stress analysis within the rectangular plate.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the basic concepts of finite element analysis, element properties and Framed structures.	Understand
CO.2	To Analyse problems on continuous beams and plane frames using finite element method.	Analyze
CO.3	To Solve problems on continuous beams and plane frames using finite element method.	Apply
CO.4	To Develop models and interpret the numerical results in design.	Analyze
CO.5	Use the modern tools to formulate the problem, and able to create geometry, descritize, apply boundary condition to solve problems of, truss, beams, to find stress with different loading conditions.	Apply
CO.6	Make an effective communication and presentation as a Individual / team in Multi storey structures Problems.	Apply

Text Books:

1. Bhavikatti.S.S, “Finite Element Analysis”, New Age International Publishers, Third Edition 2015.
2. Seshu P. “Text Book of Finite Element Analysis”, Prentice Hall, New Delhi, 2007.
3. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”,Prentice Hall of India,2014.

Reference Books:

1. 1.David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, First Edition 2017.
2. 2.Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc.,2017.
3. 3.Rao.S.S, “Finite Element Method in Engg.”, Butterworth – Heinemann, UK, Sixth Edition 2017.

21CEV108	AI FOR CIVIL ENGINEERING AND MACHINE LEARNING (Common to ALL Branches)	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To gain proficiency in collecting, processing, and analyzing large datasets related to civil engineering projects, using AI and ML tools to extract meaningful insights and inform decision-making.
- To apply principles and techniques of AI and ML, including supervised and unsupervised learning, neural networks, and natural language processing in civil engineering contexts.
- To Develop the ability to apply AI and ML algorithms to solve complex civil engineering problems, such as structural health monitoring, predictive maintenance, and construction optimization.

Unit I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN CIVIL ENGINEERING	9

Overview of Artificial Intelligence (AI) and Machine Learning (ML) - Applications of AI and ML in Civil Engineering - Basic concepts of AI and ML: supervised learning, unsupervised learning, reinforcement learning - Case studies of AI and ML applications in Civil Engineering

Unit II	DATA PRE-PROCESSING AND FEATURE ENGINEERING	9

Data collection and pre-processing techniques specific to Civil Engineering datasets - Feature selection and extraction techniques - Handling missing data and outliers - Data normalization and standardization - Dimensionality reduction techniques

Unit III	SUPERVISED LEARNING TECHNIQUES FOR CIVIL ENGINEERING	9

Regression analysis for predicting continuous variables in Civil Engineering (e.g., construction costs, material properties) - Classification algorithms for tasks such as structural health monitoring, risk assessment, and quality control - Model evaluation and validation techniques - Artificial Intelligence-Assisted Building Information

Unit IV	UNSUPERVISED LEARNING AND CLUSTERING IN CIVIL ENGINEERING	9

Introduction to unsupervised learning algorithms (e.g., k-means clustering, hierarchical clustering) - Applications of clustering in Civil Engineering, such as pattern recognition in sensor data, traffic flow analysis, and urban planning - Evaluation metrics for clustering algorithms.

Unit V	ADVANCED TOPICS IN AI AND ML FOR CIVIL ENGINEERING	9

Deep learning techniques for Civil Engineering applications - Convolutional Neural Networks (CNNs) for image-based tasks like crack detection, infrastructure monitoring - Recurrent Neural Networks (RNNs) for time-series data analysis in Civil Engineering (e.g., traffic prediction, structural health monitoring) - Transfer

learning and domain adaptation for leveraging pre-trained models in Civil Engineering contexts.

TOTAL = 45 PERIODS

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the feature selection and extraction techniques to identify and utilize the most informative features from civil engineering datasets, enhancing model performance and interpretability.	Understand
CO.2	Apply data normalization and standardization techniques to ensure that civil engineering data is appropriately scaled and comparable, which is crucial for the performance of many machine learning algorithms.	Apply
CO.3	Acquire expertise in employing classification algorithms to address diverse tasks in civil engineering, including structural health monitoring, risk assessment, and quality control.	Apply
CO.4	Learn to integrate artificial intelligence techniques with Building Information Modeling (BIM) to improve the efficiency, accuracy, and automation of construction project management and design processes.	Apply
CO.5	Analyze recent advancements in AI and ML, and applying these cutting-edge techniques to practical civil engineering problems.	Analyze
CO.6	Applydeep learning techniques to address diverse challenges in civil engineering, leveraging the power of neural networks to extract complex patterns and insights from large datasets.	Apply

Reference Books:

1. M. Z. Naser, “Machine Learning for Civil & Environmental Engineers A Practical Approach to Data-driven Analysis, Explainability, and Causality” John Wiley & Sons, Inc., Hoboken, New Jersey, 2023 (copyright).
2. Vagelis Plevris, Afaq Ahmad and Nikos D. Lagaros, “Artificial Intelligence and Machine Learning Techniques for CivilEngineering”, IGI Global book series Advances in Civil and Industrial Engineering (ACIE), 2023 (Copyright).
3. Khalid M. Mosalam and Yuqing Gao, “Artificial Intelligence in Vision-Based Structural Health Monitoring (Synthesis Lectures on Mechanical Engineering)”Springer International Publishing AG, 2024 (copyright)

21CEV201	FORMWORK ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To study and understand the overall and detailed planning of formwork, plant and site equipment..
- To impart the knowledge on From work design for special structures.
- To impart knowledge on the latest methods of form construction.
- To Select a right material for manufacturing false work and form work suiting specific requirements.

Unit I	Introduction and Formwork Materials	9

Introduction-Formwork as a Temporary structure-Requirements for form work,Selection of form work, Classification of form work-Formwork Materials-Form coatings and Mould Linings-Form lining Materials

Unit II	Formwork design concepts	9

Introduction-Loads on Formwork-The design basis-Estimating permissible stresses-Conventional form work for Foundation-Foundation formwork design.

Unit III	Formwork for structural elements	9

Wall formwork-Column formwork-Slab and Beam form work-Formwork for special structures.

Unit IV	Formwork for precast concrete	9

Introduction-Moulds for precast concrete-Precasting process-Methods-Case studies.

Unit V	Formwork Failures and Issues	9

Causes of formwork failures,and Case studies in Formwork Failure, Formwork Issues in Multi-storey Building Construction-Recommendations on safe Practices.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Select proper formwork, accessories and material.	Understand
CO.2	Design the form work for Beams, Slabs, columns,Walls and Foundations.	Apply
CO.3	Design the formwork for Special Structures.	Apply
CO.4	Analyse the Various Conditions of Special formwork.	Analyze
CO.5	Appraise and demonstrate the recent advances in the formwork design.	Apply
CO.6	Evaluate the various formwork failures in construction projects.	Evaluate

Text Books:

1. Formwork for Concrete Structures, Peurify, McGraw Hill India, 2015.

2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.

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IS Codes: (If necessary for your course)
1. IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.
2. IRC:87-2011GUIDELINES FOR FORMWORK, FALSEWORK AND TEMPORARY STRUCTURES.

21CEV202	CONSTRUCTIONEQUIPMENTANDMACHINERY	L	T	P	C
		3	0	0	3

COURSEOBJECTIVE

- Toexposethestudentsinthefieldofconstructionequipmentandmachineriessoastogainknowledgeincarr yingoutengineeringtasks.

Unit I	CONSTRUCTION EQUIPMENTS	9

Identification - Planning of equipment - Selection of equipment - Equipment management in projects - Maintenance management - Equipment cost - Operating cost - Cost control of equipment - Depreciation analysis - Replacement analysis - Safety management

Unit II	EQUIPMENT FOR EARTHWORK	9

Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders - Dozer, excavators, rippers, loaders, trucks and hauling equipment, compacting equipment, finishing equipment - Case studies on earthwork equipment

Unit III	OTHER CONSTRUCTION EQUIPMENT	9

Equipment for dredging, trenching, drag line and clamshells, tunneling - Jacking equipment - Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane - Types of pumps used in construction - Equipment for dewatering, grouting and demolition

Unit IV	ASPHALT AND CONCRETE PLANTS	9

Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment - Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment - Asphalt plant - Asphalt pavers - Asphalt compacting equipment.

Unit V	MATERIALS HANDLING EQUIPMENT	9

Forklifts and related equipment - Portable material bins - Material handling conveyors - Material handling cranes - Industrial trucks - Aerial transporting equipment.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

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COs	CO Statements	BT Levels
CO.1	Develop knowledgeonplanningofequipmentandselectionofequipment	**Understand**
CO.2	Explain the knowledge on fundamentals of earth work operations, earth moving operationsandtypesofearth workequipment	**Apply**
CO.3	Analyze the crane operation and capacities	**Analyze**
CO.4	Developtheknowledgeonspecial construction equipment	**Apply**
CO.5	Apply theknowledgeonasphaltand concrete plants	**Apply**
CO.6	Applytheknowledgeand select theproper materialshandlingequipment	**Apply**

Text Books:

1. Chitkara, K. K., Construction Project Management Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi.
2. Chitkara, K. K., Construction Project Management Techniques and Practices, Tata McGraw Hill, New Delhi, 2004

Reference Books:

1. P.S. Gahlot and B.M. Dhir, “Construction Planning and Management”, New Age International Pvt. Ltd., New Delhi.
2. Sharma, S.C., Construction Equipment & Managemetn, Khanna Publications, New Delhi, 1988.
3. Sengupta and Guha, Construction Management and Planning, Tata McGraw Hill, New Delhi.

21CEV203	SUSTAINABLE DESIGN	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

Unit I	INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION	9

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO2 contribution from cement and other construction materials - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

Unit II	ENERGY CALCULATIONS	9

Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use.

Unit III	GREEN BUILDINGS	9

Control of energy use in building – National Building Code (NBC), ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling -Performance ratings of green buildings - Zero energy building'.

Unit IV	CORE CONCEPTS IN LEAN	9

Introduction to the Course; Lean Overview; Need for Productivity Measurement and improvement; Productivity Measurement System (PMS).

Unit V	LEAN CONSTRUCTION TOOLS AND TECHNIQUES	9

Sampling/ Work Sampling; Survey/ Foreman delay survey; Value Stream/ Process Mapping– 5S , Collaborative Planning System (CPS)/ Last Planner™ System (LPS) – Big Room Approach, IT/BIM and Lean, How to Start Practicing Lean Tools in Project Site.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe the various sustainable materials used in construction.	Understand
CO.2	Estimate the amount of energy required for building.	Apply
CO.3	Interpret the features of LEED, TERI and GRIHA ratings of buildings.	Apply
CO.4	Analyze the various lean construction tools and techniques in projects.	Analyze
CO.5	Apply the various PMS techniques in projects.	Apply
CO.6	Calculate the performance ratings of zero buildings.	Apply

Text Books:

1.Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.

2.Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

Reference Books:

1.Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.

2.Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2012.

21CEV204	DIGITALIZED CONSTRUCTION LAB	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To train the students in field of digitalization of construction. Students can be trained in the latest
- softwares relevant to construction industry.

List of experiments:

To implement the digital knowledge in construction (use relevant softwares)

1. Introduction and understanding of Primavera project planner for construction
2. Using Primavera project planner, update the schedule of the project of a construction project.
3. Introduction and understanding of MS Project for a construction project
4. Using MS project, schedule the construction project planning
5. Introduction to BIM in construction projects

a. Development of BIM for small construction project

6. Progress the work flows in construction project using BIM
7. Development of bid management for a small firm construction industry using software.

TOTAL - 90 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the importance of latest softwares in a construction industry.	**Understand**
CO.2	Plan a construction project using Computer software.	**Apply**
CO.3	Plan a construction project using Computer software.	**Apply**
CO.4	Develope a BIM information model.	**Apply**
CO.5	Analyse the bid management and its effectiveness using bid management software.	**Analyze**
CO.6	Apply the importance of latest softwares in a construction industry.	**Apply**

21CEV205	CONSTRUCTIONMANAGEMENTANDSAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To study and understand the formulation, costing of construction projects, scheduling and various safety concepts and its requirements applied to construction projects.

Unit I	GENERALOVERVIEWAND PROJECTORGANIZATION	9

Introduction - Interdisciplinary nature of modern construction projects – execution of project – evaluation of bits – resource management.

Unit II	ESTIMATION OF PROJECT COST & ECONOMICS	9

Estimating quantities – description of items – estimation of project cost – running account bills – decision making in construction projects – depreciation of construction equipment – case study.

Unit III	PLANNING AND SCHEDULING	9

Introduction – project scheduling – uncertainties in duration of activities using PERT – Project monitoring and control system – resource levelling and allocation – crashing of network.

Unit IV	SAFETY DURING CONSTRUCTION	9

Basic terminology in safety - types of injuries - safety pyramid - Accident patterns - Planning for safety budget, safety culture - Introduction to OSHA regulations - Site safety programs - Job hazard analysis, accident investigation & accident indices-violation, penalty.

Unit V	SAFEOPERATINGPROCEDURES	9

Safety during alteration, demolition works – Earthwork, steel construction, temporary structures, masonry & concrete construction, cutting & welding - Construction equipment, materials handling- disposal & hand tools - Other hazards – fire, confined spaces, electrical safety

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Perform formulations of projects	Understand
CO.2	Analyze project costing	Apply
CO.3	Identify and estimate the activity in the construction	Apply
CO.4	Develop the knowledge on accidents and their causes	Analyze
CO.5	Plan, assess the construction project sites.	Apply
CO.6	Manage the construction project sites.	Apply

Text Books:

1. Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
2. Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992

Reference Books:

1. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth- Heinemann, USA, 2017.
2. Patrick X.W. Zou ,Riza YosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd 2015.

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21CEV204	DIGITALIZED CONSTRUCTION LAB	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To train the students in field of digitalization of construction. Students can be trained in the latest
- softwares relevant to construction industry.

List of experiments:

To implement the digital knowledge in construction (use relevant softwares)

1. Introduction and understanding of Primavera project planner for construction
2. Using Primavera project planner, update the schedule of the project of a construction project.
3. Introduction and understanding of MS Project for a construction project
4. Using MS project, schedule the construction project planning
5. Introduction to BIM in construction projects

a. Development of BIM for small construction project

6. Progress the work flows in construction project using BIM

7. Development of bid management for a small firm construction industry using software.

TOTAL - 90 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the importance of latest softwares in a construction industry.	**Understand**
CO.2	Plan a construction project using Computer software.	**Apply**
CO.3	Plan a construction project using Computer software.	**Apply**
CO.4	Develope a BIM information model.	**Create**
CO.5	Analyse the bid management and its effectiveness using bid management software.	**Analyze**
CO.6	Apply the importance of latest softwares in a construction industry.	**Apply**

21CEV206	ADVANCED CONSTRUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.

Unit I	SUB STRUCTURE CONSTRUCTION	9

Construction Methodology - Box jacking - Pipe jacking - Under water construction of diaphragm wallsand basement - Tunneling techniques - Piling techniques - Driving well and caisson – sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operationsfor built up offshore system - Shoring for deep cutting - Large reservoir construction - well points -Dewatering for underground open excavation.

Unit II	SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS	9

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.

Unit III	CONSTRUCTION OF SPECIAL STRUCTURES	9

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in coolingtowers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching andpushing of box decks – Construction of jetties and break water structures – Construction sequenceand methods in domes – Support structure for heavy equipment and machinery in heavy industries– Erection of articulated structures and space decks.

Unit IV	REHABILITATION AND STRENGTHENING TECHNIQUES	9

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab -Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting forfoundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub gradewater proofing, Soil Stabilization techniques.

Unit V	DEMOLITION	9

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the modern construction techniques used in the sub structure construction.	Understand
CO.2	Apply the principles and concepts relevant to super structure construction for buildings.	Apply
CO.3	Apply the concepts used in the construction of special structures.	Apply
CO.4	Apply Knowledge on Various strengthening and repair methods for different cases.	Apply
CO.5	Identify the suitable demolition technique for demolishing a building.	Evaluate
CO.6	Analyze the sustainable construction techniques and their suitability for a specific project.	Analyze

Text Books:

1. 1.Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984
2. 2.Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.

Reference Books:

1. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
2. Peter H.Emmons, “Concrete repair and maintenance illustrated”, Galgotia Publications Pvt. Ltd.,
3. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.

21CEV207	ENERGY EFFICIENT BUILDINGS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide an understanding of the concept of energy consumption in buildings and design an energy efficient building.

Unit I	INTRODUCTION	9

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

Unit II	PASSIVE SOLAR HEATING AND COOLING	9

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds– Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

Unit III	DAYLIGHTING AND ELECTRICAL LIGHTING	9

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

Unit IV	HEAT CONTROL AND VENTILATION	9

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

Unit V	DESIGN FOR CLIMATIC ZONES	9

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other
buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basics of Climate Responsive Design Considerations and Site Responsive Design Considerations in planning and design of buildings in terms of building materials, building construction & technology, building science, building services to provide energy efficiency. Explain environmental energy supplieson buildings.	Understand
CO.2	Apply passive solar heating and cooling principles in planning and design of energy efficient buildings.	Apply
CO.3	Apply concepts of day lighting and electrical lighting in planning and design of energy efficient buildings.	Apply
CO.4	Analyse the various principles of heat control and ventilation in terms of building materials and building physics to promote indoor and outdoor thermal comfort.	Analyze
CO.5	Evaluate the performance of buildings with traditional architecture and vernacular architecture in terms of energy efficiency in buildings.	Evaluate
CO.6	Create the ability to design a buildings with low energy consumption with case study visits as tool.	Create

Reference Books:

1. 1.Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2. 2.Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995.
3. 3.Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
4. 4.Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc,3rd Edition, 2014.
5. 5.Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

21CEV301	GEO-ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination,
- To import knowledge on safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment
- To import knowledge on stabilization of waste
- To provide fundamental knowledge on landfill monitoring , sources & characterization of waste

Unit I	SOIL – WASTE INTERACTION	9

Role of Geo-environmental Engineering – sources, generation and classification of wastes – causesand consequences of soil pollution – case studies in soil failure -factors influencing soilpollutantinteraction – modification of index, chemical and engineering properties – physical and physiochemicalMechanisms.

Unit II	CONTAMINANT TRANSPORT AND SITE CHARACTERISATION	9

Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process –biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ionexchange, Volatization, biodegradation – characterization of contaminated sites – soil and rock data– Hydrological and chemical data – analysis and evaluation.

Unit III	WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES	9

In-situ containment – vertical and horizontal barrier – surface cover – ground water pumping systemon subsurface drain – soil remediation – Soil Vapour extraction, soil waste stabilization, solidificationof soils, electrokinetic remediation, soil heating, vitrification, bio remediation, Phyto-remediation –ground water remediation – pump and treat , In-situ flushing, permeable reacting barrier, In-situ airsparging.

Unit IV	LANDFILLS AND SURFACE IMPOUNDMENTS	9

system – Source and characteristics of waste - site selection for landfills – components of landfills –liner soil, geomembrane, geosynthetic clay, geo-composite liner system – leachate collection – finalcover design – monitoring landfill - Environmental laws and regulations.

Unit V	STABILISATION OF WASTE	9

Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag,construction waste, wood waste and their physical, chemical and biological characteristics – potentialReuse – utilization of waste and soil stabilization

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the various causes and consequences of waste interaction with soil and theirmodification.	Understand
CO.2	Interpret the various mechanism of transport of contaminants into the subsurface and characterization of contaminated sites and their risk analysis.	Apply
CO.3	Explain how to decontaminate the site so as to reuse the site for human settlement.	Apply
CO.4	Illustrate safe disposal of waste through different containment process.	Apply
CO.5	Assess conversion of waste into a resource material through soil waste stabilization techniques with or without chemical stabilization.	Analyze
CO.6	Evaluate the soil failure and utilization of waste and soil stabilization through a case study	Evaluate

Text Books:

1. Hari D. Sharma and Krishna R. Reddy, Geo-Environmental Engineering -John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., Geotechnical Practice for waste disposal, Chapman and Hall, London 1993.
3. Manoj Datta, Waste Disposal in Engineered landfills, Narosa Publishing House, 1997

Reference Books:

1. Westlake, K, Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
2. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989

21CEV302	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Students will be exposed to various problems associated with soil deposits and methods to evaluate them
- The physical, chemical and hydraulic modification methods and its applications for strengthen the soil.
- The applications of modern methods in civil construction alteration works, short creating, soil reinforcement, soil nailing, bolting involved in inclusion and confinement process
- The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement
- Students will be exposed to various problems associated with soil deposits and methods to evaluate them

Unit I	HYDRAULIC MODIFICATIONS	9

Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.

Unit II	MECHANICAL MODIFICATIONS	9

Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation design and relative merits of various methods – Soil liquefaction mitigation methods

Unit III	PHYSICAL MODIFICATION	

Preloading with sand drains, fabric drains, wick drains – theories of sand drain - Stone column with and without encased, lime stone – functions – methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications.

Unit IV	MODIFICATION BY INCLUSIONS	9

Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control.

Unit V	CHEMICAL MODIFICATION	9

Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications	Understand
CO.2	Improve the ground characteristics by mechanical modifications using various method and design the system	Apply
CO.3	Improve the ground characteristics by physical modifications using various method and design the system	Apply
CO.4	Improve the characteristics of soils by various reinforcement techniques and design	Apply
CO.5	Analyze the ground and decide the suitable chemical method for improving its characteristics	Analyze
CO.6	Analyse the various grouting techniques and its applications for improving load bearing of beneath soil	Analyze

Text Books:

1. Pappala, A.J.,Huang,J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
2. Cox, B.R., and Grifiths S.C., Practical Recommendation for Evaluation and mitigation of Soil Liquefaction in Arkansas, (Project Report), 2010.

Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
2. Han,J., Principles and Practice of Ground Improvement, John Wiley and Sons, New Jersey, Canada 2015

21CEV303	SOIL DYNAMICS AND MACHINE FOUNDATIONS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To design different types of machine foundations based on the dynamic properties of soils
- To give an exposure on vibration isolation techniques.
- To understand the wave propagation in soils, determine dynamic properties of soil for analyzing and designing foundations subjected to vibratory loading.

Unit I	THEORY OF VIBRATION	9

Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems – Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

Unit II	DYNAMIC SOIL PROPERTIES	9

Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing actors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

Unit III	MACHINE FOUNDATIONS	9

Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring-dashpot model – Permissible amplitudes – Permissible bearing pressures

Unit IV	DESIGN OF MACHINE FOUNDATION	9

Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer –Codal recommendations - Emprical approach – Barken's method – Bulb of pressure concept – Pauw's analogy – Vibration table studies.

Unit V	VIBRATION ISOLATION	9

Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the basic design fundamentals of RC structures and its components.	Understand
CO.2	Acquire knowledge to apply theories of vibration to solve dynamic soil problems.	Apply
CO.3	Apply the basic concepts about machine foundations and design various types of machine foundation.	Apply
CO.4	Analyse the various load acting on machine foundation and suggest suitable design methods for machine foundation.	Analyze
CO.5	Analyse the dynamic properties of soil using laboratory and field tests.	Analyze
CO.6	Investigate the safe bearing capacity of dynamic soil based on both lab and field tests.	Evaluate

Text Books:

1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.
2. Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.

Reference Books:

1. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.
2. Arya, S., O'Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.
3. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.

21CEV304	ROCK MECHANICS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- The objective of the course is to provide the student with the concept and the tools that can be used to incorporate in the field of geotechnical engineering
- **failure criteria and influence of in-situ stress in the stability of various structures**
- Students are expected to classify, understand stress-strain characteristics
- various technique to improve the in-situ strength of rocks.

Unit I	CLASSIFICATION OF ROCKS	9

Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations

Unit II	STRENGTH CRITERIA OF ROCKS	9

Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rock failure planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut-off. Hoek and Brown Strength criteria for rocks with discontinuity sets.

Unit III	INSITU STRESSES IN ROCKS	9

In-situ stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods - stress around underground excavations – Design aspects of openings in rocks.

Unit IV	SLOPE STABILITY AND BEARING CAPACITY OF ROCKS	9

Rock slopes - role of discontinuities in slop failure, slope analysis and factor of safety - remedial measures for critical slopes – Bearing capacity of foundations on rocks.

Unit V	ROCK STABILIZATION	9

Stabilization of rocks-rock support and rock reinforcement-active and passive supports-ground response curve-support reaction curve-reinforcement of fractured and joined rocks-Shotcreting-bolting-anchoring-installation methods.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Classify the Rock mass and rate the quality of rock for tunnelling and foundations works and suggest the safer length of tunnelling and stand-up time.	Understand
CO.2	Apply the knowledge of engineering and understand the stress – strain characteristics and failure criteria of rock	Apply
CO.3	Apply them to arrive at the shear strength parameters of rocks to be used for the design of structures resting on rock and also for the design of underground excavation in rocks.	Apply
CO.4	Design the foundations resting on rocks. Able to carry-out suitable foundation for the structure resting on rock.	Apply
CO.5	Improve the in-situ strength of rocks by various methods such as rock reinforcement and rock support	Understand
CO.6	Apply the knowledge on rock mechanics and analyze the stability of rock slopes and arrive at the bearing capacity of shallow and deep foundations resting on rocks considering the presence of joints	Apply

Text Books:

1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.
2. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.

Reference Books:

1. Ramamurthy T., “Engineering in Rocks for Slopes Foundations and Tunnels”, PHI Learning Pvt. Ltd., 2007.
2. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.
3. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley,

21CEV305	EARTH RETAINING STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To import Knowledge on Earth pressure (Active & Passive pressure)
- To analyse and design rigid, flexible earth retaining structures, slurry supported trenches and deep cuts.
- To explore onstability analysis and design of anchor systems
- To gain knowledge on Analysis and design of cantilever and anchored sheet pile walls

Unit I	EARTH PRESSURE THEORIES	9

Introduction – State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques (Culmann's method) – Active and passive cases – Earth pressure due to external loads.

Unit II	COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES	9

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces.

Unit III	SHEET PILE WALLS	9

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method – fixed earth support method. Design of anchor systems - isolated and continuous

Unit IV	SUPPORTED EXCAVATIONS	9

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic design concepts.

Unit V	SLURRY SUPPORTED EXACAVATION	9

Slurry supported trenches-basic principles-slurry characteristics-specifications-diaphragm wallsbored pile walls-contiguous pile wall-secant piles-stability analysis.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	To understand the role of slurry in supporting excavations and to perform stability analysis by considering the actual shape of slurry support	Understand
CO.2	Interpret the earth pressure to analyse and design rigid retaining structures considering effect of compaction, wall flexibility, pore water pressure and earth quake forces.	Apply
CO.3	Interpret earth pressure to analyse and design flexible earth retaining walls and also acquire the knowledge of design of anchors	Apply
CO.4	Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations, slurry supported excavations and underground utilities.	Apply
CO.5	Analyse the earth pressure acting on retaining structures by applying classical theories considering all influencing parameters and suggest the earth pressure to be considered for the design of retaining structures	Analyze
CO.6	Assess stability Analysis for pile walls and retaining structures.	Evaluate

Text Books:

1. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, GalgotiaBooksource, 2000.
2. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, Second Edition, Survey University Press, 1993.
3. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.

Reference Books:

1. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
2. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997

21CEV306	PILE FOUNDATION	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- The student will be exposed to the design of piles
- pile groups and caissons with respect to vertical and lateral loads for various field conditions.
- to selectgeotechnical design parameters and type of pile foundations

Unit I	PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE	9

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipments and methods – effect of pile installation on soil condition – pile raft system – basic interactive analysis - criteria for pile socketing Start Contents here

Unit II	AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS	9

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results - Settlement of piles and pile group.

Unit III	LATERAL AND UPLIFT LOAD CAPACITIES OF PILES	9

Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out capacity from load test.

Unit IV	STRUCTURAL DESIGN OF PILE AND PILE GROUPS	9

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps — pile subjected to vibration.

Unit V	CAISSONS	9

Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Explain the importance of pile foundation and various functions and responsibilities of geotechnical engineer and contractor, in addition to the piling equipments	**Understand**
CO.2	Determine the vertical load carrying capacity of pile and pile group- keeping the settlement of pile as an important criteria based on field practices and codal provisions	**Apply**
CO.3	Apart from vertically loaded piles, the structures are exposed to the peculiar pile subjected to lateral and uplift load with reference to codal provision and case studies	**Apply**
CO.4	Understand the design of pile and pile caps, considering the wind and seismic loads.	**Understand**
CO.5	Explain the importance of caisson foundation and checking the stability of caissons based on codal provisions	**Understand**
CO.6	Design vertical piles and pile groups for various types of loading, soil conditions and settlement requirements.	**Apply**

Text Books:

1. Foundation Engineering, Peck hanson &Thronburg(1974). John Wiley & Sons,.
2. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWS Publishing, 1999.

Reference Books:

1. Analysis and design of Subsructures- Swami Saran (2009), Oxford & IBH
2. Foundation Engineering Naryana S Naik(2012), Dhanphat Rai publishers, New Delhi
3. Swami Saran, Gopal Ranjan, “Analysis & Design of Foundaions & Retaining Structures”, Sarita Prakashan

21CEV307	TUNNELING ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the types and purpose of tunnels
- To learn various types of Underground Excavations, planning and site investigations
- To impart knowledge on the conceptTunneling methods
- To understand the principles of Sinking of shafts

Unit I	TUNNELS AND UNDERGROUND SPACE APPLICATION	9

History-caves-tunnels for transport-water, power supply-storage of LPG –nuclear waste disposal-defence facilities-submerged tunnels-underground library, museums

Unit II	EXCAVATION TECHNIQUES	9

Types and purpose of tunnels-choice of excavation methods-soft ground tunneling-hard rock tunneling-tunnel drilling-blasting-impact hammers-problems encountered and remedial measures.

Unit III	PLANNING AND GEOMETRIC DESIGN OF TUNNELS	9

Topographical –geological survey-rock sampling-testing-determination of location size shape and alignment-subsidence problem on soft ground –tunneling design in hard rock

Unit IV	CONSTRUCTION OF TUNNEL	9

Advanced drilling techniques –TBM-cuttability assessment-shield tunneling-advantages-types of shield tunneling-factors affecting selection of shield-twin tunnel-NATM.

Unit V	DESIGN OF TUNNEL SUPPORTING SYSTEMS AND VENTILATION	9

Classification of supports-active –passive-permanent-temporary-excavation support-steel supports-lining-grouting-ground freezing-environment in underground-various methods of ventilation..

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	To Understand need of utilization of underground space for various applications.	Understand
CO.2	Identify and plan tunnel excavation method from technical, production, and sustainability point of view	Apply
CO.3	Analyze cost and time for ordinary tunnels based on risks and construction management principles.	Analyze
CO.4	Design tunnel reinforcement based on empirical, analytical and numerical assessment depending on complexity and acquire a holistic perspective on the design process.	Apply
CO.5	Evaluate tunnel excavation method from technical and production aspects	Apply
CO.6	Analyze water ingress to tunnels and identify possible water related problems for excavation/ grouting methods	Analyze

Text Books:

1. Surface and underground Excavation by Ratan Raj Tatiya
2. Introduction to Tunnel Construction David Chapman, Nicole Metje and Alfred Stark, Spon Press

Reference Books:

1. Rock Engineering, Palmström and Stille
2. Underground infrastructures “planning, design, and construction” (2012, Elsevier_ButterworthHeinemann)

21CEV401	MODERN SURVEYING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To study the basic principles and methods of hydrographic surveying.
- To get introduced to the concept of astronomy in locating a celestial body.
- To impart knowledge on the basics of aerial photogrammetry.
- To learn on the principles of Electronic distance measurements, Total station and GPS.
- To give exposure to advanced surveying techniques involved such as remote sensing, GIS,etc.

Unit I	HYDROGRAPHIC SURVEYING	9

Shore line survey - River survey- Sounding-Gauges & Equipment - Sounding Rods and Lead Lines- Sounding Chain and lead- Sounding Machine, Fathometers, Signals, Sextants- Methods of sounding- Location of soundings- Plotting of sounding-The Three point problem-Mechanical, Graphical& Analytical methods.

Unit II	ASTRONOMICAL SURVEYING	9

Celestial sphere - astronomical terms and definitions - motion of sun and stars - apparent altitude and corrections - celestial co-ordinate systems - spherical trigonometry – latitude and longitude of a place - field observations and calculations for azimuth- Nautical almanac.

Unit III	AERIAL PHOTOGRAMMETRY	9

Photogrammetry- types and geometry of aerial photograph- Photographic scale- Flying heights and altitude- Relief and tilt displacement – corrections – Flight Planning-Layout of Photography

Unit IV	EDM, TOTAL STATION,GPS SURVEYING	9

Electromagnetic distance measurement (EDM) – principle – types – Total station- working principle, GPS Basics – system overview – working principle of GPS – Satellite ranging – Calculating position- GPS Survey-types-Kinematic and static survey techniques.

Unit V	BASICS OF REMOTE SENSING&GIS	9

Introduction – Historical Background - Electromagnetic Radiation (EMR) - Electromagnetic Spectrum -. Airborne Platforms-Sensors -Types-optical Remote Sensing,Microwave remote sensing-Applications of Remote sensing-LIDAR,GIS-History of Development - Components of GIS- Data models – Raster and Vector data structures- – Advanced applications of GIS.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the Hydrographical survey, Astronomical, Aerial Photogrammetry, Advance survey equipment	Understand
CO.2	Apply the location identification through software	Apply
CO.3	Locate a celestial body using different co-ordinate systems in astronomical surveying.	Evaluate
CO.4	Evaluate Interpret and scale aerial photographs.	Evaluate
CO.5	Apply total station and EDM in distance measurement and traversing.	Apply
CO.6	Adopt advanced surveying techniques over conventional methods in the field of civil engineering	Evaluate

Text Books:

1. SatheeshGopi, “Advanced Surveying”, Pearson Education,2007.
2. Kanetkar T.P., “Surveying and Levelling”, Vols. I and II, Standard Publishers, New Delhi 2008.
3. SatheeshGopi, “The Global Positioning System and Surveying using GPS”, Tata McGraw,2005.

Reference Books:

1. Bannister A and Raymond S, “Surveying”, Addison Wesley Longman ltd, England,2006.
2. Bossler, J.D., “Manual of Geospatial Science and Technology”, Taylor and Francis,2002.
3. Burrough, P.A. and McDonnell, R.A., “Principles of Geographic Information System”, Oxford University Press,2000.
4. Duggal R.K, “Surveying” Vol. I and II, Tata McGraw Hill Publishing Company Ltd., New Delhi,2004.

21CEV402	APPLICATION OF REMOTE SENSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

Unit I	REMOTE SENSING AND ELECTROMAGNETIC RADIATION	9

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities

Unit II	EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL	9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

Unit III	ORBITS AND PLATFORMS	9

Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit.

Unit IV	SENSING TECHNIQUES	9

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV

– Orbital and sensor characteristics of live Indian earth observation satellites

Unit V	DATA PRODUCTS AND INTERPRETATION	9

Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys

-Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL - 45 Periods

Course Outcomes:

On completion of the course, the student is expected to be able to

COs	CO Statements	BT Levels
CO.1	Understand the concepts and laws related to remote sensing	Understand
CO.2	Apply the interaction of electromagnetic radiation with atmosphere and earth material	Apply
CO.3	Acquire knowledge about satellite orbits and different of satellites	Evaluate
CO.4	Evaluate the different types of remote sensors	Evaluate
CO.5	Create the interpretation of satellite imagery	Create
CO.6	Apply data analysis process in field requirement	Apply

Text Books:

Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.

George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third Edition Universities Press (India) Private limited, Hyderabad, 2018

Reference Books:

1.Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, AmericanSociety of Photogrametry, Virginia, USA, 2002.

2.Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995

3.Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.

4.Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication

5.Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

21CEV403	SATELLITE IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To make the undergraduate Engineering Students understand the concepts, principles, processing of Satellite data in order to extract useful information from them.

Unit I	FUNDAMENTALS OF IMAGE PROCESSING	9

Information Systems - Encoding and decoding - acquisition, storage and retrieval –data products - satellite data formats - Digital Image Processing Systems - Hardware and software design consideration Scanner, digitizer - photo write systems.

Unit II	SENSORS MODEL AND PRE PROCESSING	9

Image Fundamentals – Sensor models – spectral response – Spatial response – IFOV,GIFOV& GSI – Simplified Sensor Models – Sampling & quantization concepts – Image Representation& geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration- Interpolation methods and resampling techniques.

Unit III	IMAGE ENHANCEMENT	9

Image Characteristics - Histograms - Scattergrams – Univariate and multi variate statistics-enhancement in spatial domain – global, local & colour Transformations – PC analysis, edge detections, merging - filters - convolution – LPF, HPF , HBF, directional box, cascade – Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations - Fourier, wavelet and curvelet transformations

Unit IV	IMAGE CLASSIFICATION	9

Spectral discrimination - pattern recognition concepts - Baye‘s approach - Signature and training sets – Separability test –Supervised Classification – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA,K-means-Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers - Accuracy assessment – Error matrix – Kappa statistics – ERGAS, RMS.

Unit V	ADVANCED CLASSIFIERS	9

Fuzzy set classification – sub- pixel classifier – hybrid classifiers, Texture based classification – Object based classifiers – Artificial Neural nets – Hebbian leaning – Expert system, types and examples – Knowledge systems

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand about satellite data and its processing systems	Understand
CO.2	Apply knowledge about the satellite image and do the necessary correction on preliminary processing from satellite image.	Apply
CO.3	Apply the knowledge to utilize the basic enhancement techniques for image processing and restoration activities	Apply
CO.4	Analyze the advanced image classification methods and conduct lifelong research in the field of image processing.	Analyze
CO.5	Classify the satellite image using various method and evaluate the accuracy of classification	Analyze
CO.6	Apply knowledge to develop a basic land use / land cover map of the area	Apply

Text Books:

1. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 4th Edition, 2015.
2. Robert, A. Schowengergt, Techniques for Image Processing and classification in Remote Sensing, Academic Press, 2012.

Reference Books:

1. Robert, G. Reeves,- Manual of Remote Sensing Vol. I & II - American Society of Photogrammetry, Falls, Church, USA, 1983.
2. Richards, Remote sensing digital Image Analysis - An Introduction 5th Edition ,2012, Springer -Verlag 1993.
3. Digital Image Processing by Rafael C. Gonzalez,Richard Eugene Woods- Pearson/ Prentice Hall,2008
4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2006)
5. Digital Image Processing: PIKS Scientific Inside by William K. Pratt 4th Edition,Wiley Interscience,2007.

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21CEV404	CARTOGRAPHY AND GIS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce concepts of Cartography and GIS
- To expose the process of map making and production
- To introduce GIS data structures, data input and data presentation

Unit I	ELEMENTS OF CARTOGRAPHY	9

Start ConteDefinition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents – Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – Indian Maps and Projections – Map Co-ordinate System – UTM and UPS References. Start Contents herents here

Unit II	MAP DESIGN AND PRODUCTION	9

Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformation

Unit III	FUNDAMENTALS OF GIS	9

Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models.

Unit IV	DATA INPUT AND TOPOLOGY	9

Scanner – Raster Data Input – Raster Data File Formats – Georeferencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.

Unit V	DATA QUALITY AND OUTPUT	9

Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression	Understand
CO.2	Be familiar with co-ordinate and Datum transformations	Evaluate
CO.3	Be familiar with appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.	Design
CO.4	Apply the concepts of spatial data quality and data standard	Apply
CO.5	Evaluate the concept of spatial data inputs	Evaluate
CO.6	Apply the concept of topology and attribute data	Apply

Text Books:

1. Arthur H. Robinson et al, “Elements of Cartography”, 7th Edition, Wiley, 2002
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.

Reference Books:

1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004
2. Chor Pang LO, Albert K. W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Pearson Education, 2nd Edition, November 2016.

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21CEV405	PHOTOGRAMMETRY	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To Understanding of problems of municipal waste, biomedical waste, hazardous waste, ewaste, industrial waste etc.
- Knowledge of legal, institutional and financial aspects of management of solid wastes.
- Become aware of Environment and health impacts solid waste mismanagement
- Understand engineering, financial and technical options for waste management

Unit I	PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY	9

Start CHistory - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetry project Planningontents here

Unit II	GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS	9

Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement –- Photo Interpretation.

Unit III	STEREOPLOTTERS & ORIENTATION	9

Projection system, Viewing, Measuring and Tracing system Stereo plotters–Classification: Analog, semi analytical, Analytical and Digital systems – Interior orientation - Relative orientation – Absolute orientation - Collinearity condition and Coplanarity condition - Orientation: Two-dimensional coordinate transformations – Three-dimensional conformal coordinate transformation

Unit IV	AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO	9

model – Strip and blocks of photographs – Aerotriangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aerotriangulation (INS and GNSS integration) - feature collection – DTM generation and Contour mapping – ortho rectification - mono plotting – stereo plotting.

Unit V	DIGITAL PHOTOGRAMMETRY	9

Photogrammetric Scanner – Digital Photogrammetry WorkStation – Work Station Basic system function – Storage System – Stereoscopic Viewing and Measuring System – Image properties - Image matching: template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand and appreciate the importance of photography as means of mapping, functional and physical elements of photography.	Understand
CO.2	Evaluate the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large-scale maps with scientific methods	Evaluate
CO.3	Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production	Analyze
CO.4	Apply the process of reconstructing three-dimensional model for the real world	Apply
CO.5	Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology.	Analyze
CO.6	Evaluate the standards of map based on the state-of-the-art tool and techniques and assess the production standards for photogrammetric map making.	Evaluate

Text Books:

1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4thEdition, 2014
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001
3. Manual of Photogrammetry – American society of Photogrammetry & amp; R. S by Albert. D, 1980.

Reference Books:

1. Gollfried Konecny, Geoinformation: Remote Sensing, Photogrammetry and Geographical Information Systems, CRC Press, 2nd Edition, 2014.
2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co.2nd Edition, 2007.
3. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009

21CEV406	AIRBORNE AND TERRESTRIAL LASER MAPPING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the concepts of Space Borne, Air Borne, Terrestrial and Bathymetric LASER Scanners for Topographic and Bathymetric Mapping

Unit I	SPACE BORNE RADAR AND LIDAR ALTIMETER	9

Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Types of LiDAR:Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borne LiDAR – Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea Surface Topography , Moon Topography - Merits of ALS in comparison to Levelling, echo sounding, GPS leveling, Photogrammetry and Interferometry Start Contents here

Unit II	AIRBORNE LASER SCANNERS	9

Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser –First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software - Various Scanning Mechanisms: Oscillating Mirror, Rotating Polygon, Nutating Mirror, Fibre Optic

Unit III	DATA ACQUISITION AND PRE-PROCESSING	9

Laser Classification – Class I to Class IV Laser – Eye Safety - Synchronization of GPS, IMU and ALS Data - Reflectivity of terrain objects –- Flight Planning – Determination of various data acquisition parameters – Swath Width, Point Density, No. of Strips, Area Covered, Point Spacing - Data Processing – Determination of optimal flight trajectory- Quality Assurance

Unit IV	POST PROCESSING of LiDAR Data	9

Post Processing – Geo location of Laser Foot Prints – Various Co-ordinate Transformations involved Filtering - Ground Point filtering – Digital Surface Model and Digital Elevation Model - LIDAR data file formats – LAS File format and other proprietary file formats – Post Processing Software: Open Source and COTS Software – Quality Control Measures – Error Budget - Overview of LIDAR Applications in various domains - 3D city models – Corridor Mapping Applications – Forestry Applications.

Unit V	TERRESTRIAL LASER SCANNERS	9

Terrestrial Laser Scanners (TLS) – Working Principle – Static TLS – Dynamic TLS –- Commercial TLS Specifications – Mobile Mapping Lasers :Vehicle Mounted TLS, Back Pack Wearable Laser Scanners – Asset Management Studies – Highways and Railway Asset Management – Indoor Mapping : Laser Scanning of interior of buildings/monuments – Immersive Applications - BIM Model – Applications in Tunnel Surveying, Forest Inventory, Open Cast Mine Surveying

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the components of laser and various platforms of laser scanning	Understand
CO.2	Summarize the components of Airborne Laser Scanner and concept of ranging principles	Evaluate
CO.3	Analyze the flight planning parameters and pre-processing of acquired data	Analyze
CO.4	Evaluate post process the data to derive DSM and DEM and its applications	Evaluate
CO.5	Apply the components of TLS and its applications	Apply
CO.6	Create the BIM Model, application of Tunnel survey	Create

Text Books:

1. Jie Shan, Charles K. Toth, “Topographic Laser Ranging and Scanning – Principles and Processing”, 2nd Edition, CRC Press Publication, March 2018. ISBN: 9781498772273.

Reference Books:

1. George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning, WhittlesPublishing, 2010
2. Matti Maltamo, Erik Næsset, JariVauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht , 2016,Reprint Edition. ISBN 978-94- 017-8662-1
3. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013

21CEV407	HYDROGRAPHIC SURVEYING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide the necessary knowledge and practical instrument operational and data processing skills needed for them to confidently accomplish a bathymetric survey in the real world
- To develop students' critical and creative thinking, as well as cooperative attitudes & behaviour of working with others.

Unit I	INTRODUCTION, TIDES AND DATUMS	9

Overview of hydrographic surveying concepts- bathymetric and nautical charts- Basic tidal theory-tidal observations and predictions - common types of recording tide gauges - different vertical datums - Indian tides. Start Contents here

Unit II	SOUNDINGS	9

Overview of depth data types- Working principle of echo sounders - characteristics and nature of underwater acoustic signals – transducers - error sources and calibrations- Advanced instrumentation.

Unit III	NAVIGATION AND POSITION FIXING	9

Horizontal positioning methods and requirements - concept of line and surface of position - positioning and navigation using satellite positioning systems - differential GPS and Real-time kinematic (RTK)

Unit IV	PLANNING AND DATA PROCESSING	9

General considerations for planning of an inshore hydrographic survey - ground and track control - practical soundings in inshore and coastal surveys - data processing and chart compilation - hydrographic software packages for data collection - processing and plotting.

Unit V	MARINE ENVIRONMENTAL MEASUREMENTS	9

Methods of measuring and recording of currents - composition of the sea bed - and solids in suspension - Case Studies (The role of the hydrographic surveyor on different marine projects)

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the fundamentals of hydrographic surveying	Understand
CO.2	Evaluate the appropriate techniques for different types of survey	Evaluate
CO.3	Analyze the various options available during the Navigation	Analyze
CO.4	Analyze the data collected from a survey and assess its quality against the project requirements	Analyze
CO.5	Discuss the different roles for a hydrographic surveyor on marine projects	Evaluate
CO.6	Apply the GPS and Real-time kinematic (RTK)	Apply

Text Books:

U.S. Army Corps of Engineers, (2002), Hydrographic Surveying, Document No. EM 1110-2-1003

Reference Books:

1. de Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A. (2002), Hydrography, Delft University Press, The Netherlands.
2. Ingham, A. E. (1992), Hydrography for the Surveyor and Engineer, 3rd Edition revised by Abbott V. J., Blackwell Science.
3. International Hydrographic Organisation (1998), IHO Standards for Hydrographic Surveying (S- 44), IHB Monaco.
4. Loweth, R. P. (1997), Manual of Offshore Surveying for Geoscientists and Engineers Chapman & Hall.
5. Pugh, D. (2004), Changing Sea Levels – Effects of Tides, Weather and Climate, Cambridge University Press.
6. Sonnenberg, G. J. (1988), Radar and Electronic Navigation, Butterworths.

21CEV501	RAILWAY AIRPORT AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To Introduce component of railway tracks, track resistance, crossing, signaling.
- To deal with the characteristics of aircrafts related to airport design; runway and taxiway design, runway orientation, length, grading and drainage.
- To explain the classes of harbors, features, planning and design of port facilities.

Unit I	RAILWAY PLANNING	9

Development of railways in India - Comparison of roadways and railways - Components of a permanent way and its functions - Rails, Gauges, Sleepers, Ballast, Formation, Rail fittings and fastenings - Coning of wheels - Defects in rails: creep in rails, Track Stress - Gradient and Grade compensation on curves - Speed on curves – Super elevation and Negative super elevation - Maximum Permissible speed on curve (Problems included) - Widening of gauge on curves.

Unit II	RAILWAY CONSTRUCTION AND MAINTENANCE	9

Track construction - Calculation of Materials required for track laying - Track maintenance - Track drainage - Types of stations: Way side, Junction, Terminal - Types of station yards: Passenger, Goods, Marshalling and Locomotive - Introduction to Modern Developments in Railways

Unit III	Points & Crossings, Signalling & Interlocking	9

Types of Points / Switch: Stub, Split switch - Types of crossing: acute angle, Obtuse angle, Square – Design calculation of Turnout - Various types of Track junctions - Signaling and Interlocking - Different types of signals, their working and location - Control systems of signals - Mechanical method of interlocking systems - Track circuiting.

Unit IV	Airport Planning and Design	9

Introduction - classification of airports - Factors influencing the selection of new airport site and ICAO stipulations - layout characteristics, socio-economic characteristics of the Catchment area - components of Airport Runway Orientation: Wind Rose Diagram - Problem on Basic and Actual runway length - Aircraft Parking system - Drainage - Airport Zoning - Runway and Taxiway Markings and lighting - Design standards and planning of Airport as per Indian condition.

Unit V	HARBOUR ENGINEERING	9

Water Transportation- Types of water transportation -Ports and Harbours –requirements, classification. Harbour works: breakwaters, jetties, fenders, piers, wharves, dolphins, etc., Navigational aids: types, requirements, light house, beacon lights, buoys, Port facilities: general layout, development, planning, facilities, terminals. Docks and repair facilities: design, dry docks, wet docks, slipways, Locks and lock gates: materials, size, Dredging: classification, dredgers, uses of dredged materials.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Demonstrate standards and norms of national and International organizations which are framed for efficient functioning of existing transport systems	.Understand
CO.2	Interpret the functioning of various components of transportation system	Apply
CO.3	Recommend the basic design of Railway,Airport,Harbour layout.	Apply
CO.4	Compare different transportation systems and their importance and their role in development.	Analyze
CO.5	Analyze the various signal system,Visual Aids and Markings help in safe working of transportation system.	Analyze
CO.6	Evaluate the new technologies used and trends used and trends adopted in present transport scenario.	Evaluate

Text Books:

1. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi, 2003
2. Satish Chandra and Agarwal M.M, "Railway Engineering", 2nd Edition, Oxford University Press, New Delhi, 2013.
3. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nemchand and Brothers, Roorkee, 2012.
4. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 2013

Reference Books:

1. Rangwala, "Railway Engineering", Charotar Publishing House, 2013.
2. Rangwala, "Railway Engineering", Charotar Publishing House, 2013.
3. Rangwala, "Railway Engineering", Charotar Publishing House, 2013.
4. P.Purushothama Raj"Laxmi Publications2017
5. Oza.H.P. and Oza.G.H., "A course in Docks & Harbour Engineering". Charotar Publishing Co., 2013
6. Mundrey J.S. "A course in Railway Track Engineering". Tata McGraw Hill, 2007
7. Srinivasan R. Harbour, "Dock and Tunnel Engineering", 26th Edition 2013.

21CEV502	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To give an overview of Traffic engineering, various surveys to be conducted, traffic Regulation, management and traffic safety
- To infer the basic concepts of traffic engineering and its fundamentals which includes road dimensions and norms.
- To discuss the traffic management and safety systems being followed and its implications in road network planning.

Unit I	TRAFFIC SURVEYS AND ANALYSES	9

Traffic characteristics: Human, vehicular, and Pavement Characteristics, Problems- presentation of traffic volume data, Annual Average Daily Traffic, Average Daily Traffic, Design hourly traffic volume; Speed- spot speed, presentation of spot speed data, speed and delay studies, methods of conducting spot-speed studies and Speed and Delay studies; Problems Origin and Destination – methods of conducting the survey and presentation of data; parking surveys, presentation of data and analyses, determination of parking demand; Accident studies and analyses; Different problems.

Unit II	TRAFFIC FLOW AND ROADWAY CAPACITY	9

Traffic Flow Characteristics – Basic traffic manoeuvres, Traffic stream flow characteristics, Speed- Flow-Density Relations; Passenger Car Units – Mixed traffic flow and related issues – Concept of PCU value- Factors affecting PCU values- Recommended PCU values for different conditions; Capacity and Level of Service – Factors affecting practical capacity – Design Service Volumes

Unit III	COST – EFFECTIVE TRAFFIC MANAGEMENT TECHNIQUES	9

Traffic System Management: Regulatory Techniques- one way street, Reversible Street, Reversible lane, Turning moment restrictions, closing streets; Traffic Control Devices – Traffic Signs – Road Markings, Traffic Signals, Miscellaneous traffic control devices; Traffic Segregation – Vehicle segregation, Pedestrian segregation, Traffic signals design; Bus Priority Techniques – Priority manoeuvres – With-flow bus lane and contra-flow bus lane; Self- Enforcing Techniques- Demand Management Techniques (TDM)

Unit IV	DESIGN OF ROAD INTERSECTIONS	9

Importance and Classification; Intersections at-grade – uncontrolled, channelised; Rotary intersections (problems)- Signalised intersections (problems)- Grade Separated Intersections – merits and demerits, types, pattern of intersections with different types of interchanges- Capacity, Concept diagrams.

Unit V	DESIGN OF PARKING AND PEDESTRIAN FACILITIES AND CYCLE TRACKS	9

Parking: Need for parking studies and its ill effects- Parking Standards for different land uses, different types of parking - Conceptual plans for different types of parking; **Pedestrians:** Importance, Barriers, Behaviour, Pedestrian facilities – Principles of planning, Level of Service (LoS), Design standards.;

Cycle Tracks: Principles of design, Design criteria, Design standards for Rural Expressways.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the principles of traffic flow characteristics and their relationships	Understand
CO.2	Analyze various traffic management measures in addressing the demand Pricing and ITS applications.	Analyze
CO.3	Apply the knowledge of science and engineering fundamentals in conducting traffic surveys, analyze the problems and relating it with standards	Apply
CO.4	Designing various types of control and regulatory measures to meet an efficient traffic network.	Create
CO.5	Analyze the facilities and plan for Non Motorised Transport	Analyze
CO.6	Apply the intersections and the junctions in the road network with respect to standards and norms	Apply

Text Books:

1.Kadiyali. L.R. Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.

2.Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014.

3.Srinivasa Kumar, “Introduction to Traffic Engineering”, Universities Press, 2018

4.Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011.

5.Papacosta.P.S and Prevedouros.P.D, “ Transportation Engineering and Planning, third edition, 2015

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Reference Books:

1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.
2. Khanna S. K, and others, Highway Engineering, Nam Chand & Bros, Roorkee, 2014, Pages 177 – 308.
3. C. JotinKhisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998
4. Taylor MAP and Young W, Traffic Analysis – New Technology and New Solutions, Hargreen Publishing Company , 1998.
5. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996.
6. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998

21CEV503	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To study town planning concepts and theories.
- To perceive the concept of urbanization and various growth patterns.
- To study norms and aspects of land use planning policies and survey techniques.
- To study the concepts for different area planning.
- To study the concepts related to planning surveys

Unit I	Evolution of Town Planning	9

Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas –Positive and negative impacts of urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

Unit II	PLANNING PROCESS AND THEORIES	9

Principles of Planning –Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radbun Concept, Neighbourhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept

Unit III	DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION	9

Types of plans – Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town- Development Plan, urban nodes, Smart City Plan -Scope and Content of Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP – Case Studies.

Unit IV	PLAN IMPLEMENTATION	9

Objectives and Principles of Urban planning- Different Land use planning norms- Environmental aspects of land use planning,- DTCP guidelines in Town planning - Land use- demand and supply of land relationship- Government policies of urban development - Role of Professional bodies.

Unit V	URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS	9

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Comprehend the planning standards, evaluate the constraints and the financial mechanism	Understand
CO.2	Analyze the impact of urbanization on socio economic levels of cities.	Analyze
CO.3	Analyze the characteristics of Urban Environment using the demand and supply of land.	Analyze
CO.4	Apply the urban planning theories in developing urban centers & layouts.	Apply
CO.5	Apply the planning parameters recommended by DTCP in Land use planing.	Apply
CO.6	Apply the concept of urban planning process during programme planning	Apply

Text Books:

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

Reference Books:

1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai
2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005

21CEV504	SMART CITY TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To make the students understand the core challenges relating to the foundation of sustainable smart cities
- To impart knowledge on understanding, and critical thinking related to smart, sustainable urban development.
- To explore issues relating to the development and deployment of new and emerging technologies, that will create a thorough understanding of smart processes and systems of the present and future.
- To gain in- depth knowledge to implement smart wastewater management system in smart cities.
- To apply the concept of Internet of Things in real world scenario.

Unit I	INTRODUCTION	9

Understanding – Dimensions – Feasibility Analysis, Global experience, Global standards and performance bench marks, Practice codes. India 100 smart cities policy and mission, Smart city planning and development, financing smart cities development, Governance of smart cities.

Unit II	GREEN BUILDING CONCEPTS AND SUSTAINABLE DEVELOPMENT	9

Green projects in smart cities, sustainability – green building – Rating system – Energy efficient building – energy saving systems.

Unit III	SMART URBAN TRANSPORT & EMERGENCY RESPONSE SYSTEM	9

Introduction- Intelligent Public Transport – Parking - Traffic Control Systems- Applications of IoT. Surveillance systems- Emergency response – Incident management systems. Urban transport planning process –Transport, environment and safety issues. Principles and approaches of Traffic Management, Transport System Management.

Unit IV	SMART WATER, SEWERAGE AND WASTE MANAGEMENT	9

Introduction-Water Supply -Sewerage & Waste management - Smart Water and Sewerage Management System-. Waste Collection and Transportation Monitoring system – IoT and Sensors - Case study.

Unit V	E- GOVERNANCE AND IOT	9

The concept of management, concept of e-management & e-business, e-Government Principles, Form e-Government to e-governance, e-governance and developing countries, Designing and implementing e-Government Strategy, E-governance: Issues in implementation. IOT fundamentals, protocols, design and development, data analytics and supporting services, case studies.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the fundamental concepts of smart cities and green building with technology advancement.	Understand
CO.2	Apply knowledge of engineering, energy, and information technology for smart city architecture.	Apply
CO.3	Design and develop responsive smart cities with green buildings, intelligent transport system, smart water and drainage networks.	Apply
CO.4	Outline the application of smart technologies in water supply, sewerage waste management transportation sector.	Apply
CO.5	Recognize the role of modern ICT and data analytics in addressing the urban challenges and key issues.	Apply
CO.6	Analyze the importance and role of government, urban planners, city developers, universities and stakeholders for smart city development.	Analyze

Text Books:

1. Aniket Bhagwat, Suparna Bhalla, Sanjay Prakash Ashish Bhalla Destination 100 (The Making of Smart Cities in India, Future Institute publishers, 2014. (ISBN 13: 9781 4392 57883).
2. Vinod kumar T. M., Geographic Information Systems for Smart Cities, Copal Publishing, New Delhi, 2014.(ISBN: 9788 1924 73352).
3. Komakech, D., ‗Achieving More Intelligent Cities‖, Municipal Engineer, 2005.
4. Nohrstedt, ‗Digital Planning: Integrating New Information and Communication Technologies in Urban Planning‖, www.oruse.com, 2002.
5. Peng, L., Tao, Z., ‗Establish the Intelligent City System and Realize its Level Analysis‖, Telematics and Informatics, 2010.

Reference Books:

1. Allen G.Noble, (Eds), ‗Regional Development and Planning for the 21st Century: New Priorities and New Philosophies‘, Aldershot, USA, 1988.
2. Andy Pike, AndresRodriguez-Pose, John Tomaney, ‗Handbook of Local and Regional Development‘, Taylor & Francis, 2010
3. Andreas Faludi and Sheryl Goldberg, ‗Fifty years of Dutch National Physical Planning, Alexandrine Press, Oxford, 1991.
4. Daniel G. Parolek, AIA, Karen Parolek, Paul C. Crawford, FAICP, Form Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers, John Wiley & Sons, 2008

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21CEV505	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To learn the fundamentals of ITS.
- To study the ITS functional areas
- To have an overview of ITS implementation in developing countries

Unit I	INTRODUCTION TO ITS	9

Fundamentals of ITS: Definition of ITS, Challenges in ITS Development-Purpose of ITS Deployment- Benefits of ITS- Overview of application of ITS in Transportation Planning

Unit II	DATA COLLECTION THROUGH ITS	9

Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT)

Unit III	ITS IN TRAFFIC MANAGEMENT	9

ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveler Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections

Unit IV	ITS IN TRANSPORTATION PLANNING	9

ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations – public transportation applications- Weight –in Motion

Unit V	ITS APPLICATION IN LOGISTICS	9

Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics-E commerce

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the fundamentals of ITS and its benefits.	Understand
CO.2	Analyze data collection using sensors and its applications	Analyze
CO.3	Evaluate acquainted with the knowledge of ITS in Traffic Management	Evaluate
CO.4	Application of ITS in Transportation Planning	Apply
CO.5	Analyze the application of ITS in Logistics	Analyze
CO.6	Apply the ITS functional areas	Apply

Text Books:

1. R. Srinivasa Kumar,"Intelligent Transportation Systems", Universities Press P Ltd, Telangana, 2022.

Reference Books:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US,2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill,1992

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21CEV506	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements.
- Further, the student will be in a position to assess quality and serviceability conditions of roads.

Unit I	PAVEMENT MATERIALS AND SUBGRADE ANALYSIS	9

Introduction – Pavement as layered structure – Pavement types -rigid and flexible-Subgrade analysis- Stress and deflections in pavements- Pavement Materials and Testing- Modified Binders.

Unit II	DESIGN OF FLEXIBLE PAVEMENTS	9

Flexible pavement design – Advantages and disadvantages -Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.

Unit III	DESIGN OF RIGID PAVEMENTS	9

Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.

Unit IV	PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE	9

Construction Techniques practice of flexible and concrete pavement Pavement Evaluation – Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

Unit V	STABILIZATION OF PAVEMENTS	9

Stabilization with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilization for rural roads in India – Use of Geosynthetics in roads.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Get knowledge about types of rigid and flexible pavements.	Understand
CO.2	Design a pavement system using design of rigid pavements	Apply
CO.3	Design a pavement system using design of flexible pavements	Apply
CO.4	Apply different pavement design methods to a complex pavement project.	Apply
CO.5	Determine the causes of distress in rigid and flexible pavements.	Analyze
CO.6	Analyze the effectiveness of different maintenance strategies for pavement systems.	Analyze

Text Books:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand andBrothers, Revised 10th Edition,2014.
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khannatech. Publications,New Delhi,2015.

Reference Books:

1. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley2000.
2. Guidelines for the Design of Flexible Pavements, IRC-37–2012, The Indian roads Congress, NewDelhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2018, The Indian Road Congress, NewDelhi.

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21CEV507	HOUSING PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To acquire knowledge on planning and execution of geotechnical site investigation.
- To understand the design parameters of different type of foundations as per code.
- To familiarize the concept of earth pressure theories and retaining wall analysis.
- To understand the pile foundation, its type, capacity and settlement.

Unit I	INTRODUCTION TO HOUSING	9

Definition: House, Home, Household -Row houses, Apartments, Multi storied Buildings, Special Buildings- Objectives and Strategies of National Urban Housing and Habitat Policy (NUHHP) 2007 &NUHHP, 2017- Principle of Sustainable Housing-Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies -DC Regulations, Institutions for Housing at National, State and Local levels.

Unit II	HOUSING PROGRAMMES	9

Basic Concepts, Contents and Standards for various Housing Programmes Sites and Services, Neighborhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing - Slum Housing Programmes:location, redevelopment, improvements, Use of GIS and MIS in Slum Housing projects- Public, Private and NGOs role in Slum Housing.

Unit III	PLANNING AND DESIGN OF HOUSING PROJECTS	9

Housing Programmes: Introduction- Types- Schemes implemented by State & Central Governments- Plan outlays for various housing schemes - Formulation of Housing Projects –Byelaws & Development control Regulations -Site Analysis, Layout Design,- Procedure for site analysis and layout planning - Design of Housing Units (Simple design problems)- Housing project cost analysis

Unit IV	CONSTRUCTION TECHNIQUES AND COST- EFFECTIVE MATERIALS	9

New Constructions Techniques – Cost Effective Modern Construction Materials, Sustainable low-cost housing techniques & practices of Laurie Becker - Building Centers – Concept, Functions and Performance Evaluation- Green materials.

Unit V	HOUSING FINANCE & PROJECT APPRAISAL	9

Economic appraisal of Housing /plotted development projects.– Housing Finance-Agencies involved in financing housing projects- Cost Recovery –Cash Flow Analysis, Subsidy and Cross Subsidy, Pricing of Housing Units(Problems), Rents & Recovery Pattern (Problems).

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Interpret the various housing programme using sustainability concept.	Understand.
CO.2	Plan the housing projects as per NUHHP & Building regulations.	Apply.
CO.3	Analyze the housing project based on area of plot and cost of projects.	Analyze.
CO.4	Design the Slum housing projects using GIS & MIS Design.	
CO.5	Evaluate the cost-effective construction materials & techniques for mass housing.	Evaluate
CO.6	Present the Performance of economic analysis-based project appraisal of housing projects. Communication.	Evaluate

Text Books:

1. Venkatramaiah, C. “Geotechnical Engineering”, New Age International Publishers, New Delhi, 2017.
2. Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers and Distributers Ltd., New Delhi, 2015.
3. Arora K.R. “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 2011.
4. Punmia, B.C. Soil Mechanics and Foundations”, Laxmi Publications Pvt.Ltd., New Delhi, 2005.

Reference Books:

1. GopalRanjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi, 2016.
2. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2012.
3. Das, B.M, “Principles of Geotechnical Engineering”, Thompson Brooks/ Coles Learning, Singapore, 5th Edition, 2014.
4. Purushothma Raj P “Soil Mechanics and Foundation Engineering” 2nd Edition, Pearson Education, 2013.
5. Bowles J.E, “Foundation Analysis and design”, McGraw-Hill, 1994.

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IS Codes: (If necessary for your course)
1. IS 6403 - Code for practice of bearing capacity of shallow foundation.
2. IS 2911 - Code for practice of Pile foundation (Section 1 & 2).
3. IS 5121-1969 – safety coding of pile.
4. IS 2950 -1 (1981) – Code of Practice for design and Construction of raft foundation.
5. IS 14458 – 1997 Guidelines for Retaining wall on hill area (Part 1 & 2)
6. GopalRanjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi, 2016.
7. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2012.
8. Das, B.M, “Principles of Geotechnical Engineering”, Thompson Brooks/ Coles Learning, Singapore, 5th Edition, 2014.
9. Purushothma Raj P “Soil Mechanics and Foundation Engineering” 2nd Edition, Pearson Education, 2013.

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21CEV601	CLIMATE CHANGE ADAPTATION AND MITIGATION	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students

Unit I	INTRODUCTION	9

Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle

Unit II	ELEMENTS RELATED TO CLIMATE CHANGE	7

Greenhouse gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

Unit III	IMPACTS OF CLIMATE CHANGE	10

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

Unit IV	MITIGATING CLIMATE CHANGE	9

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapotranspiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration.

Unit V	ALTERNATE FUELS AND RENEWABLE ENERGY	9

Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy – biofuels – Energy policies for a cool future - Energy Audit

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties	**Understand**
CO.2	An insight into carbon cycle, physical basis of the natural greenhouse effect	**Analyze**
CO.3	Evaluate to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy	**Evaluate**
CO.4	Evaluate to gain in-depth knowledge on climate models	**Evaluate**
CO.5	Post process the model outputs for climate impact assessment, know about adaptation strategies	**Apply**
CO.6	Analyze the meaning of the term radioactive forcing, climate change, global warming	**Analyze**
CO.6	and measures to adapt and to mitigate the impacts of climate change	

Text Books:

1. Ruddiman W.F, freeman W.H. and Company, “Earth‟s Climate Past and Future”, 2001
2. Velma. I. Grover “Global Warming and Climate” Change. Vol I an II. Science Publishers, 2005.
3. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

Reference Books:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK, 2007
2. Thomas E, Lovejoy and Lee Hannah “Climate Change and Biodiversity”, TERI Publishers, 2005
3. Jan C. van Dam, Impacts of “Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.

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21CEV602	AIR AND NOISE POLLUTION CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge on the sources, effects and control techniques of air pollutants and noise pollution

Unit I	GENERAL	9

Atmosphere as a place of disposal of pollutants – Air Pollution – Definition - Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards - National ambient air quality standards - Air pollution indices - Air quality management in India.

Unit II	SOURCES, CLASSIFICATION AND EFFECTS	9

Sources and classification of air pollutants - Man made - Natural sources - Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods.Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions - Changes on the Meso scale, Micro scale and Macro scale

Unit III	SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING	9

Sampling and measurement of particulate and gaseous pollutants - Ambient air sampling - Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate - Wind Rose - Inversion – Wind velocity and turbulence - Plume behavior - Dispersion of air pollutants- Air Quality Modeling

Unit IV	AIR POLLUTION CONTROL MEASURES	9

Control - Source correction methods - Control equipments - Particulate control methods – Bag house filter - Settling chamber - cyclone separators - inertial devices - Electrostatic precipitator - scrubbers - Control of gaseous emissions - Absorption - Absorption equipments - adsorption and combustion devices (Theory and working of equipments only).

Unit V	NOISE POLLUTION AND ITS CONTROL	9

Sources of noise – Units and Measurements of Noise - Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures – Effects of noise pollution – auditory effects, non-auditory effects. Noise Menace– Prevention and Control of Noise Pollution – Control of noise at source, control of transmission, protection of exposed person - Control of other types of Noise Sound Absorbent

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand various types and sources of air pollution and its effects	**Understand**
CO.2	Analyze the dispersion of air pollutants and their modeling	**Analyze**
CO.3	Analyze about the principles and design of control of particulate pollutants	**Analyze**
CO.4	Design of control of gaseous pollutant	**Design**
CO.5	Analyze the sources, effects and control of vehicular, indoor air and noise pollution	**Analyze**
CO.6	Apply the noise pollution and air pollution in the field	**Apply**

Text Books:

1. C. S. Rao, “Environmental Pollution Control Engineering”, Wiley Eastern Limited, 2006
2. M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 2017
3. Dr. Y. Anjaneyulu, “Air Pollution and Control Technologies”, Allied publishers Pvt. Ltd., 2019

Reference Books:

1. Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000.
2. Air Pollution act, India, 1987
3. Peterson and E.Gross Jr., “Hand Book of Noise Measurement”, 7th Edition, 1974
4. Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986
5. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 1979.
6. Kenneth wark, Cecil F.Warner, “Air Pollution its Origin and Control”, Harper and Row Publishers, New York, 1998.

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21CEV603	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.

To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	INTRODUCTION	9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation

Unit II	IMPACT INDENTIFICATION AND PREDICTION	10

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modelling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment

Unit III	SOCIO-ECONOMIC IMPACT ASSESSMENT	8

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

Unit IV	EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN	9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

Unit V	CASE STUDIES	9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the principle of limit state design for concrete pipe design	**Understand**
CO.2	structural design of Water tanks	**Create**
CO.3	Design the water treatment plant Structures	**Create**
CO.4	Design the components of wastewater treatment plant structures	**Create**
CO.5	Apply the knowledge of structural design to various environmental engineering structures	**Apply**
CO.6	Apply the knowledge of Environmental design to building structures	**Apply**

Reference Books:

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996
2. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley- Interscience, New Jersey. 2003
3. World Bank –Source book on EIA
4. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999
5. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York,1996.
6. K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990
7. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4th Edition, Butterworth Heineman, 2012.

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21CEV604	INDUSTRIAL WASTEWATER MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
- Understand principles of various processes applicable to industrial wastewater treatment .
- Identify the best applicable technologies for wastewater treatment from the perspective of yield production

Unit I	INTRODUCTION	8

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling – generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management

Unit II	INDUSTRIAL POLLUTION PREVENTION &WASTE MINIMISATION	8

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries

Unit III	INDUSTRIAL WASTEWATER TREATMENT	10

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation- Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorousremoval, Ion exchange, Adsorption, Membrane Filtration, Electro dialysis & Evaporation –Removal of Organic Constituents – Biological treatment Processes, Chemical OxidationProcesses, Advanced Oxidation processes – Treatability Studies

Unit IV	WASTEWATER REUSE AND RESIDUAL MANAGEMENT	9

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrialwastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion,conditioning, dewatering and disposal of sludge – Management of ROreject

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Unit V	CASE STUDIES	9

Industrial manufacturing process description, wastewater characteristics, source reduction optionsand waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the source and types of industrial wastewater and	**Understand**
CO.2	Identify industrial wastewater pollution and implement pollution prevention, waste minimization in industries	**Analyze**
CO.3	Apply knowledge and skills to design industrial wastewater treatment schemes	**Apply**
CO.4	Analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques	**Analyze**
CO.5	Conduct research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable	**Create**
CO.6	Environmental impacts and choose the regulatory laws pertaining to environmental protection	**Evaluate**

Text Books:

1. "Industrial wastewater management, T reatment & disposal, Water Environment" Federation Alexandria Virginia, Third Edition, 2008.
2. Lawrance K. Wang, Yung Tse Hung, Howard H.Lo and Constantine Yapijakis “handlook of Industrial and Hazardous waste Treatment”, Second Edition, 2004.
3. Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017

Reference Books:

1.Nelson Leonard Nemerow, “ industrial waste Treatment”, Elsevier, 2007.
2. Wesley Eckenfelder W., “ Industrial Water Pollution Control”, Second Edition, Mc Graw Hill, 2000.
3. Paul L. Bishop, Pollution Prevention: - Fundamentals and Practice", Mc-Graw Hill International, Boston, 2000.
4. Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata McGraw Hill, 2007

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21CEV605	MUNICIPAL SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart the knowledge and skills to identify and assess the waste storage, collection, transfer, handling and disposal measures.
- To provide the knowledge on issues of solid waste management.
- To give an overview of legislation and regulations of solid waste management

Unit I	INTRODUCTION TO SOLID WASTE MANAGEMENT	9

Need and objectives – waste management hierarchy – Functional elements – Environmental impact of mismanagement – solid waste: Sources, types, composition, quantities, physical, chemical and biological properties

Unit II	STORAGE, COLLECTION & TRANSFER	9

General considerations for waste storage at source – factors affecting storage and collection - collection services – collection system, equipments, time and frequency of collection – labour requirement - collection routes – preparation of master schedules - Need for transfer operation - – transfer stations – types: Transfer stations – selection of location, types & design requirements, operation & maintenance

Unit III	PROCESSING & DISPOSAL OF MUNICIPAL SOLID WASTE	9

Processing technologies: composting, incineration and pyrolysis. Energy recovery from solid waste – Bio-methanation. Disposal: Landfill and its introduction – Essential components – site selection – Land filling methods – Leachate analysis and landfill gas management – treatment and disposal. Municipal solid waste management rules 2016.

Unit IV	BIOMEDICAL WASTE MANAGEMET & HEALTH ASPECTS	9

Biomedical waste: sources and generation – classification of biomedical waste – management technologies. Health Aspects: handling, processing, segregation, recovery, recycling and reuse of solid waste. Public involvement and participation in solid waste management practices. Biomedical waste management rules 2016

Unit IV	INDUSTRIAL & E-WASTE MANAGEMENT	9

Industrial waste: sources – types – collection and disposal – control measures – recycling. E-waste: sources – types – recycling – disposal. Dangers of E-waste. E – Waste management Rules 2016

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the waste management hierarchy and identify opportunities to minimize solid waste production.	**Understand**
CO.2	Analyze the suitable site for landfill and processing facility.	**Analyze**
CO.3	Evaluate physical and chemical analysis of municipal solid wastes and	**Evaluate**
CO.4	Integrate technical solid waste management options and imposed environmental legislation to develop legal and safe solutions.	**Evaluate**
CO.5	Prepare a route optimization for a solid waste collection and transport system.	**Apply**
CO.6	Apply them for a management system that will be set up.	**Apply**

Text Books:

1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018.
2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management – Science and Engineering , Butterworth-Heinemann, 2016.

Reference Books:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, “Manual on Municipal Solid waste management, Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press, Taylor and Francis Group,2014.
6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons, Wiley, 2010

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21CEV606	ENVIRONMENTAL LAWS AND POLICIES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.
- To equip the students with the skills needed for interpreting laws, policies and judicial decisions.
- To explore issues relating to the development and deployment of new and emerging technologies, that will create a thorough understanding of smart processes and systems of the present and future

Unit I	INTRODUCTION	9

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration –Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MOEF)

Unit II	WATER (P & CP) ACT, 1974	8

Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III	AIR (P & CP) ACT, 1981	8

Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit IV	ENVIRONMENT (PROTECTION) ACT, 1986	12

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards.

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Unit V	OTHER TOPICS & ISO 14000 SERIES	8

Relevant Provisions of Indian Forest Act, Background and development of ISO 14000 series Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases. Environmental law in India: Environmental policy and laws.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the key principles of, and actors within, environmental laws.	**Understand**
CO.2	Analyze environmental laws within various contexts	**Analyze**
CO.3	Evaluate laws against procedural and substantive criteria.	**Evaluate**
CO.4	Analyze legal knowledge and the Legal system operating in India and will be in a position	**Analyze**
CO.5	Evaluate compliance reports for getting environmental clearance	**Evaluate**
CO.6	To know the origins and sources of environmental laws, and understand how and by whom environmental laws are made and interpreted.	**Apply**

Text Books:

1. Shyam Divan and Armin Roseneranz “Environmental law and policy in India” Oxford University Press, New Delhi, 2001.
2. Dr Nishtha Jaswal Dr. P S Jaswal “Environmental Law” Allahabad Law Agency, 2017.

Reference Books:

1. 1 CPCB, “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
2. Greger I. Megregor, “Environmental law and enforcement”, Lewis Publishers, London1994.
3. Constitution of India [Referred articles from part-III, part-IV and part-IV A]
4. Pares Distn. Environmental Laws in India (Deep, Latest edition.)
5. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
6. The ISO 14000 Handbook: Joseph Cascio.

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7. ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).

8. ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001:1996b(E)).

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21CEV607	ENVIRONMENTAL HEALTH AND SAFETY	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To educate overview of EHS in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System

Unit I	INTRODUCTION	9

Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of trade union safety representatives – Ergonomics

Unit II	OCCUPATIONAL HEALTH AND HYGIENE	10

Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria

Unit III	WORKPLACE SAFETY AND SAFETY SYSTEMS	11

Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels

Unit IV	HAZARDS AND RISK MANAGEMENT	8

Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies

Unit V	ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT	7

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the need for EHS in industries and related Indian regulations	**Understand**
CO.2	Analyze various types of Health hazards, effect	**Analyze**
CO.3	Analyze various types of Health assessment and control methods	**Analyze**
CO.4	Evaluate the methodology for preparation of Emergency Plans and Accident investigation	**Evaluate**
CO.5	Apply the EHS Management System and its elements	**Apply**
CO.6	Apply the safety measurements	**Apply**

Text Books:

1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India
2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007

Reference Books:

1. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005.
2. Environmental and Health and Safety Management by Nicholas P.Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995

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21CEV701	WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To enable the students to understand the regional and global experiences of participatory ideology in irrigation water management
- To help students acquire knowledge on paradigms shifts and reorientations with regard to stakeholder participation in water management in general and in irrigation management in particular.

Unit I	FUNDAMENTALS OF SOCIOLOGY AND PARTICIPATORY APPROACH	6

Basic Sociological concepts and Definitions - Objectives – Perspectives- Social stratification – Sociological understanding - Irrigation as a Sociotechnical Process - paradigm shift and Participatory approach

Unit II	UNDERSTANDING FARMERS PARTICIPATION	12

Need of farmers participation –Benefits of farmers participation – Comparisons of cost and benefit

Water User Association –- Membership - Kinds of participation – National and International Experiences - Activities on Water towards Organization and Structure - Context of participation-factors in the environment.

Unit III	ROLE OF STAKEHOLDERS AND THE UNDERLYING ISSUES	12

Multiple use of water – Issues in sectoral Water Allocation - Domestic, Irrigation, Industrial sectors - Woman as a water user –Constraints and Opportunities. Role of Community Organisers – Constraints in Organising farmers Organisation

Unit IV	IMPROVING AGENCY RELATIONS AND INSTITUTIONAL REFORMS	10

Supporting farmer organization and participation -Decision Making- Leadership and responsibilities – Development strategy – Channels for implementation –– Equity and Equality- Agency Incentives- Technical co-operation – Special roles – Agency Roles- Institutional Reforms

Unit V	POLICY CONSIDERATIONS AND EMERGING CHALLENGES	5

Water Policy-Irrigation Governance-Building from Below-Non-political Associations-Bureaucratic Reorientation-Policy options and Alternatives and Sustainability

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understanding of recommendation for improved irrigation management with a vision to transform the existing governance and	**Understand**
CO.2	Acquire a clear insight into the subject matter of participatory ideology with its rudiments under the light of both national and international illustrative cases.	**Evaluate**
CO.3	Comprehend the roles of different players as stakeholders with the ground reality of the underlying issues in farm community.	**Analyze**
CO.4	Articulate as how reforms can help build up institutional and irrigation agencies with the support obtained from the existing farm network in irrigation Management	**Apply**
CO.5	Analyze policies with the novel approach of sustainability	**Analyze**
CO.6	Capture to fundamental concepts and terms which are to be applied and understood all through the study.	**Apply**

Text Books:

1. Desai A.R., Rural sociology in India, Popular Prakashan, Bombay, 1969
2. Michael C.M., Putting people first, Sociology variables in Rural Development, Oxford University press, London 1985
3. Uphoff. N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, New West - View press, Boulder and London, 1986.
4. Chambers R., Managing canal irrigation, Oxford IBM publishing Co. Pvt. Ltd., New Delhi, 1998
5. Korten F.F and Robert Y. Siy, Jr. Transforming a Bureaucracy – The experience of the Philippines National Irrigation Administration, Ateneo De Manila University Press, Manila, 1989.

Reference Books:

1. Sivasubramanium K., Water Management SIMRES Publication, Chennai 2009
2. http://irapindia.org/IMTInIndia-Pa
3. http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf

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21CEV702	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers,
- To understand the techniques of development and management of groundwater
- To impart knowledge on Well hydraulics & assess the quality of water as per Environmental Regulatory requirements
- To gain knowledge on water conservation & treatment

Unit I	HYDROGEOLOGICAL PARAMETERS	9

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GECnorms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well

Unit II	WELL HYDRAULICS	9

Unsteady state flow - Theis method - Jacob method – Chow's method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery

Unit III	GROUNDWATER MANAGEMENT	9

Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model

Unit IV	GROUNDWATER QUALITY	9

Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements

Unit V	GROUNDWATER CONSERVATION	9

Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR)Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the importance of artificial recharge and groundwater quality concepts	**Understand**
CO.2	Develop a model for groundwater management.	**Apply**
CO.3	Assess various methods in well hydraulics	**Analyze**
CO.4	Interpret the measures for prevention of sea water intrusion.	**Analyze**
CO.5	Apply knowledge of ground water conservation to recharge ground water.	**Apply**
CO.6	Evaluate the quantity and quality of ground water by Conduct ground water survey work.	**Evaluate**

Text Books:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.

Reference Books:

1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998

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21CEV703	WATER RESOURCES AND IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the concept of hydrological aspects and measurement.
- To impart required knowledge on Irrigation principles, soil water relationship, Irrigation methods and management practices.
- To provide an understanding of the diversion structures and canal irrigation

Unit I	PRECIPITATION AND ABSTRACTIONS	9

Hydrologic cycle – watershed – catchment characteristics – factors affecting: precipitation – types and forms of precipitation, measurement of precipitation, Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods – Evaporation, factors affecting evaporation, measurement of evaporation – Evapo-transpiration – factors affecting evapo-transpiration, measurement of evapo-transpiration, infiltration – Factors affecting infiltration, measurement of infiltration, infiltration indices.

Unit II	RUN OFF	9

Factors affecting run off – Run off estimation using empirical – Strange's table and SCS methods – Stage discharge relationships-flow measurements- Hydrograph – Unit Hydrograph – IUH - Flood estimation and Routing.

Unit III	IRRIGATION PRINCIPLES	9

Irrigation – Necessity and importance – Advantages and disadvantages – Standards for irrigation water – Crop water requirement: Soil, Moisture and Plant Relationship – Crops and crop seasons in India – Duty, Delta, Base Period – Factors affecting Duty – Irrigation requirements of crops – Consumptive use of water.

Unit IV	DIVERSION STRUCTURES AND CANAL IRRIGATION	9

Head works – Weirs and Barrage – Types of Spillways – Energy dissipators – Classification of canals – Alignment of canals – Design of irrigation canals – Regime theories, Kennedy's and Lacey's Regime theory – Canal Head works – Canal regulators – Canal drops – Cross drainage works – Canal Outlet, Escapes – Lining and maintenance of canals – Aqueducts, types of aqueducts

Unit V	METHODS OF IRRIGATION AND MANAGEMENT	9

Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation – ridge and furrow irrigation-Irrigation scheduling – Water distribution system – Irrigation efficiencies – Planning and Development of irrigation projects - Participatory irrigation management with case studies

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the various phases of the hydrological cycle and the features of irrigation processes.	**Understand**
CO.2	Apply the principles of hydrology and irrigation to estimate hydrological components, irrigation water requirement, methods and efficiency.	**Apply**
CO.3	Analyze the various components of the irrigation management system and hydraulic structures using principles of hydrological sciences	**Analyze**
CO.4	Analyze the variation of discharge with respect to time for the given watershed, using unit hydrograph principle	**Analyze**
CO.5	Design suitable water conveyance systems and irrigation channels that meet the specified needs with appropriate consideration for the societal and environmental considerations	**Create**
CO.6	Apply the water quality, hydrological and irrigation methods to provide an efficient water and irrigation management system for a given scenario	**Apply**

Text Books:

1. Subramanya .K. "Engineering Hydrology", Tata McGraw Hill Education, 2017.
2. Jayarami Reddy .P. "A Textbook of Hydrology", Laxmi Publications, 2016.
3. Punmia B.C., et. al; “Irrigation and water power Engineering”, Laxmi Publications,16th Edition, New Delhi, 2019.
4. Garg S. K., “Irrigation Engineering and Hydraulic structures”, Khanna Publisher, 23rd Revised Edition, New Delhi, 2009.

Reference Books:

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. VenTe Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill Education, 2017.
3. Raghunath .H.M., "Hydrology", New Age International Pvt. Ltd., 2015.
4. Michael A.M., “Irrigation Theory and Practice”, 2nd Edition, Vikas Publication House Pvt. Ltd., Noida, UP, 2008.
5. Dilip Kumar Majumdar, “Irrigation Water Management: Principles and Practice”, Prentice-Hall of India, New Delhi, 2013.

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21CEV704	WATERSHED CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide the technical and sociological understanding of a watershed
- To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits

Unit I	WATERSHED CONCEPTS	9

Watershed – Definition, Need and Elements – Principles - Influencing Factors: Geology – Soil – Morphological Characteristics - Toposheet - Delineation – Codification – Prioritization – Watershed Atlas.

Unit II	SOIL CONSERVATION MEASURES	9

Types of Erosion – Water and Wind Erosion: Causes, Factors, Effects and Management – Soil Conservation Measures: Agronomical and Mechanical – Design of Terraces and Bunds - Estimation of Soil Loss – USLE Equation – Sedimentation

Unit III	WATER HARVESTING AND CONSERVATION	9

Yield from a Catchment - Traditional Water Harvesting Techniques – Micro-Catchments - Design of Small Water Harvesting Structures: Farm Ponds, Percolation Tanks, Check dams, Grassed Waterways.

Unit IV	GIS FOR WATERSHED MANAGEMENT	9

Applications of Remote Sensing and Geographical Information System - Role of Decision Support System – Conceptual Models and Case Studies.

Unit V	WATERSHED MANAGEMENT	9

Project Proposal Formulation - Watershed Development Plan – Entry Point Activities – Watershed Economics - Agroforestry – Grassland Management – Wasteland Management – Watershed Approach in Government Programmes – People's Participation – Evaluation of Watershed Management Programmes – Integrated Watershed Management – Case studies.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand recognize and Interpret the morphological features of a watershed.	**Understand**
CO.2	Analyze the State, design and sketch the soil conservation structures	**Analyze**
CO.3	Evaluate the micro catchment and	**Evaluate**
CO.4	Application of modern tools and technology in the management of watershed.	**Apply**
CO.5	Classify the management activities and to develop an integrated watershed development plan	**Evaluate**
CO.6	Apply the concepts to design the small water harvesting structures.	**Apply**

Text Books:

1. Ghanashyam Das, Hydrology and Soil Conservation Engineering, Prentice Hall of India Private Limited, New Delhi, Second Edition, 2009.
2. Suresh, R. Soil and Water Conservation Engineering, Standard Publishers and Distributors Private Limited, New Delhi, 2020.

Reference Books:

1. Glenn O Schwab. etal, Soil and Water Conservation engineering, Wiley India Private Limited, 2009.
2. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley and Sons, Inc., New York, Second Edition 2009.
3. John G. Lyon, GIS for Water Resources and Watershed Management, CRC Press, 2002
4. Vijay P. Singh, Donald K. Frevert, Watershed Models, CRC Press, 2005.
5. Vir Singh, Raj, Watershed Planning and Management, Bio- Green Publisher, 2016

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21CEV705	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

Unit I	CONTEXT FOR IWRM	9

Water as a global issue: Key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

Unit II	WATER ECONOMICS	9

Economic view of water issues: Economic characteristics of water good and services – Non-market monetary valuation – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

Unit III	LEGAL ANDREGULATORYSETTINGS	9

Basic notion of law and governance: Principles of International and National law in the area of water management - Understanding UN law on non-navigable uses of International water courses - International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework: Case Studies.

Unit IV	WATER AND HEALTH WITHIN THE IWRMCONTEXT	9

Links between water and health: Options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies

Unit V	AGRICULTURE IN THE CONCEPT OF IWRM	9

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security - Climate Smart Agriculture - Current water pricing policy– Scope to relook pricing

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the context and principles of IWRM;	**Understand**
CO.2	Evaluate the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies	**Evaluate**
CO.3	Analyze the conventional and integrated ways of water management.	**Analyze**
CO.4	Analyze the linkages between water-health; develop a HIA framework	**Analyze**
CO.5	Apply the virtual water concept pave way to alternate policy options	**Apply**
CO.6	Apply law and governance in the context of IWRM	**Apply**

Text Books:

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. Fourth Edition 2018.
2. Mollinga.P. etal “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.

Reference Books:

1. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background Paper No: 3. Global water partnership, Stockholm, Sweden. 1999.
2. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002
3. Technical Advisory Committee, Effective Water Governance”. Technical Advisory Committee Background Paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
4. Tony Allan, Virtual Water: Tackling the Threat to Our Planet’s Most Precious Resource, I. B. Taurus, 2011.
5. Convention on the Law of the Non-navigational Uses of International Watercourses. https://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf

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21CEV706	URBAN WATER INFRASTRUCTURE	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge and skills relevant to water management in the context of urbanization and relate engineering principles to water supply, storm water and wastewater management, along with related regulations and best management practices from around the world.

Unit I	URBAN ECOSYSTEM	9

Cities as Ecological system – hybrid ecosystem – Resilience in urban ecosystem. Human components of Ecosystem – Urban pattern and Ecosystem function. Population and Community dynamics, functions of Urban Ecosystem

Unit II	URBANHYDROLOGY	9

The urban hydrological cycle – Function – Human induced changes in urban watershed – Hydrological calculation – Runoff – Infiltration – hydrograph.

Unit III	URBAN STORM WATERMANAGEMENT	9

Design of Drainage System – Roadway Drainage Analysis – Types of inlet – inlet design – Design of storm drain - Storm water management regulations - structural storm management systems – Newer trends in storm water management (Green infrastructure) – installation – operation and maintenance

Unit IV	WATER CONSERVATION AND REUSE	9

Trends in supply and demand – indoor conservation – outdoor conservation – water reuse – Rainwater harvesting – public education

Unit V	WATER GOVERNANCE	9

Challenges in water sector - Institutional setting, Supply Management, Demand Management, Waste water management – Private sector participation, urban service delivery, customer satisfaction, financial resource management – case studies of best practices in cities across the world

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand various functional elements of urban ecosystem	**Understand**
CO.2	Evaluate urban runoff, compute supply and demand of water, draw hydrograph	**Evaluate**
CO.3	Analyze advantages of Newer techniques of green infrastructure and illustrate benefits	**Analyze**
CO.4	Evaluate the Operation and Maintenance needs of urban water systems	**Evaluate**
CO.5	Evaluate the best management practices for Indian context	**Evaluate**
CO.6	Applyurban service delivery, customer satisfaction, financial resource management	**Apply**

Text Books:

1. AnandChiplunkar, K Seetharam and CheonKheong (ed) (2012), "Good Practices in urban water management" ADB, National University Singapore.
2. Marina Alberti (2008), "Advances in Urban Ecology", SpringeR
3. Mohammad Karamouz, Ali Moridi, Sara Nazif (2010), Urban Water Engineering and Management, 1st Edition, CRC Press
4. Monzur A. Imteaz , (2019), Urban Water Resources, CRC Press

Reference Books:

1. HormozPazwash (2016), "Urban storm water management", CRC Press
2. Larry W. Mays, (2004), Urban Stormwater Management Tools, McGraw-Hill Companies
3. J Parkinson, O Mark (2005) Urban Stormwater Management in Developing Countries, IWA Publishing

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21CEV707	WATER QUALITY AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the fundamentals of mathematical models and their importance in water quality modelling, and to impart the skills to use water quality modelling software for surface and groundwater qualitymodelling.

Unit I	MODELLING INSIGHTS	9

Engineers and Mathematical models-Water quality models – historical development - different types of models-- steps in model development - importance of model building.- calibration and verification of models- finite element, finite difference and finite volume methods

Unit II	POLLUTION TRANSPORT	9

Transport phenomena – advection, diffusion, dispersion- contamination transport in surface and subsurface water - Simple transport models –steady state and time variable solutions- conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport

Unit III	SURFACE WATER QUALITY MODELLING	9

Water quality modeling of streams, lakes and estuaries – water quality– model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens and COD, BOD-Streeter Phelp's model for point and distributed sources – modified streeter Phelp's equations

Unit IV	GROUNDWATER QUALITY MODELLING	9

Groundwater flow and mass transport of solutes – groundwater quality modelling using numerical methods – Parameters, Input-output stresses, Initial and Boundary conditions- degradation of organic compounds in subsurface – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation – seawater intrusion – basic concepts and modeling

Unit V	WATER QUALITY MANAGEMENT MODELS	9

Exposure to surface water and groundwater quality modelling software's – MIKE 21, WASP, QUAL2E and MODFLOW – demonstration – case studies – Modeling multilayer groundwater flow system – Artificial recharge feasibility through modeling – Groundwater contamination, restoration and management

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the pollutant transport phenomena in surface and groundwater	**Understand**
CO.2	Evaluate the principles of water quality modeling	**Evaluate**
CO.3	Analyze the water quality of rivers, lakes and estuary.	**Analyze**
CO.4	Analyze the groundwater contamination transport	**Analyze**
CO.5	Apply water quality of surface and sub-surface water using numerical solution	**Apply**
CO.6	Apply the knowledge of surface water quality modeling	**Apply**

Text Books:

1. Steven C. Chapra, “Surface Water Quality Modelling”, Tata McGraw-Hill Companies, Inc., New Delhi2018.
2. Water Quality Modelling for Rivers and Streams” Authors: Benedini, Marcello, Tsakiris, George, Springer Netherlands2017.

Reference Books:

1. **“**Hydrodynamics and Water Quality**:** Modelling Rivers, Lakes, and Estuaries”, Zhen-Gang Ji, John Wiley & Sons,2018
2. “Modelling Groundwater Flow and Contaminant Transport By Jacob Bear, A. H.-D. Cheng, Springer Science & Business Media,2010.
3. “Mathematical Modelling of Groundwater Pollution” Ne-Zheng Sun, Alexander Sun, Springer New York, 2012

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21CEV801	OCEAN WAVE DYNAMICS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To make the students be aware of ocean wave classification, the mass, momentum and wave energy transformations and wave kinematics that are happening in nature and enable them in the prediction and analysis of the wave data.

Unit I	CONSERVATION EQUATIONS OF FLUID FLOW	9

Start C Basic equations – Conservation of mass, moment and Energy - Continuity Equation, Euler's Equation, Newtonian Fluids, Navier-Stokes Equation.ontents here

Unit II	WAVE THEORIES	9

Linear wave theory : Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period. Introduction to non-linear wave theories - Stokes, Cnoidal and Solitary wave theory.

Unit III	WAVE KINEMATICS	9

Wave celerity, water particle velocities, accelerations, displacements and pressures. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.

Unit IV	WAVE TRANSFORMATIONS	9

Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenter number, Ursell Parameter, Scattering parameter, Reynolds Number

Unit V	WAVE ANALYSIS	9

Short term wave analysis- Short term wave Height Distribution – Wave period Distribution - Time and Frequency domain Analysis of Wave Records - Long term wave analysis – Gumbel Distribution – Weibull Distribution - Statistics analysis of grouped wave data.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the wave forces on fixed and floating structures	**Understand**
CO.2	Evaluate the relative balance of potential and kinetic energies for each of the five fundamental types of oceanic waves in a flat-bottomed ocean	**Evaluate**
CO.3	Analyze relation between atmosphere and sea states, and wave modeling and spectra.	**Analyze**
CO.4	Analyze the linear and nonlinear wave theories including the Stokes theory, solitary and cnoidal wave theories.	**Analyze**
CO.5	Analyze the properties of ocean waves in deep and coastal waters, and mechanisms of wave generation.	**Analyze**
CO.6	Apply the model for long term and short term waves.	**Apply**

Text Books:

1. Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co., New York, 1981
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994
3. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, inc., New York, 1978

Reference Books:

1. Coastal Engineering Manual Volume I and II, Coastal Engineering Research Centre, Dept, of the Army, US Army Corps of Engineers, Washington DC, 2006
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, New York, 1978.

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21CEV802	MARINE GEOTECHNICAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Students mainly focused in understanding the physical and engineering properties of marine soil deposits and select suitable marine foundation as per project requirements.

Unit I	MARINE SOIL DEPOSITS	9

Start Marine environment, Physical and engineering properties of marine soils - Specific problems related to marine soil deposits.Contents here

Unit II	SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS	9

Challenges of site investigation in marine environment, Different site investigation techniques, sampling techniques, Geophysical methods, Recent advancements in site investigation and sampling used for marine soil deposits.

Unit III	BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING	9

Effect of wave loading on foundations of marine structures, Behavior of marine deposits under cyclic loading, Cyclic behavior of soils based on fundamental theory of mechanics, Approximate engineering methods

Unit IV	FOUNDATIONS IN MARINE SOIL DEPOSITS	9

Different offshore and nearshore foundations, Gravity platforms, Jack-up rigs, pile foundations. cassions, spudcans.

Unit V	MARINE FOUNDATIONS SUBJECTED TO WAVE LOADING	9

Cyclic behavior of soils, empirical models, elastic-plastic models, FEM analysis of marine foundations subjected to wave loading.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the physical and engineering properties of marine soil deposits	**Understand**
CO.2	Evaluate the effect of wave loading on physical and engineering properties of marine soil deposits	**Evaluate**
CO.3	Analyze program for marine soil deposits	**Analyze**
CO.4	Evaluate suitable marine foundation as per project requirement	**Evaluate**
CO.5	Apply the Geotechnical problems related to offshore oil exploration and production	**Apply**
CO.6	Evaluate and make use of a standard report of marine site investigations	**Evaluate**

Text Books:

1. D. Thomson and D. J. Beasley, “Handbook of Marine Geotechnical Engineering”, US Navy, 2012

Reference Books:

1. H. G. Poulos. “Marine Geotechnics”, Unwin Hyman Ltd, London, UK, 1988
2. D. V. Reddy and M. Arockiasamy, “Offshore Structures”, Volume: 1, R.E. Kreiger Pub and Co., 1991

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21CEV803	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide the students the knowledge of coastal environment and to determine the characteristics of waves.
- To provide the students the knowledge of wave transformation, sediment transport, coastal protection measures and coastal structure design.

Unit I	COASTAL ENVIRONMENT	9

Start Contents here Beaches - Coastal features - Coastal Zonation - EEZ -Inshore and Offshore Areas - Mean Sea level - Basics of Tides and Waves - Coastal Morphology.

Unit II	WAVES DYNAMICS	9

Basics of waves - Classification - Wave Theory - Physical Characteristics of different types of waves - Linear Wave Theory - Wave celerity - Velocities -Accelerations - Displacements - Wave dynamics in shallow and deep water conditions.

Unit III	NEARSHORE WAVE TRANSFORMATION	9

Shoaling, refraction, diffraction and breaking– Interaction currents and waves- near shore currents-wave run-up and overtopping

Unit IV	SEDIMENT DYNAMICS AND TRANSPORT	9

Introduction to sediments, Sediment Analysis, types and sizes of sediments, sedimentation processes, sediment Supply & movement - Cross-shore sediment transport - Long shore sediment transport - Shoreline Changes - Shoreline Evolution - Erosion & Accretion.

Unit V	SHORE PROTECTION	9

Design of shore defense structures; Hard Engineering measures - Sea walls, Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures – Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation, Bioshields - Case studies

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concepts of coastal environment.	**Understand**
CO.2	Evaluate sea state parameters (wave height, wave period, water levels) in shallow and deep water conditions.	**Evaluate**
CO.3	Apply near-shore wave transformation.	**Apply**
CO.4	Analysis the sediment and its transport processes.	**Analyze**
CO.5	Evaluate measures to protect beaches from erosion due to waves and currents.	**Evaluate**
CO.6	Design of shore defense structures model	**Create**

Text Books:

1. Kamphuis, J.W., Introduction to coastal engineering and management, 2000
2. 2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice- Hall, Inc., Englewood Cliffs, New Jersey, 1994.
3. 3 Mani J.S, “Coastal Engineering book”, PHI Publishing Company, 2nd Edition, 2021.

Reference Books:

1. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., New York, 1978.
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, NewYork, 1978.
3. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC,2006.

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21CEV804	OFF SHORE STRUCTURES	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the offshore environment, types, suitability, and design concepts of offshore structures as per the appropriate requirements.
- Students will get familiar with Offshore structures
- Students are familiar with equipments and operation for dredding.

Unit I	INTRODUCTION TO OFFSHORE ENVIRONMENT	9

Start Co Ocean winds-characterization of wind regime-wind velocity profile, Ocean waves-wave parameters-Introduction to Airy's wave theory and its applications-brief about time and frequency domain analysis, brief introduction about ocean currents-tides, seaquakes, Ice environment, Ice-sea interactions.ntents here

Unit II	TYPES OF OFFSHORE STRUCTURES	9

Offshore Structures-need for offshore structures.Types of Offshore Structures -components - materials used-design parameters-suitable environment conditions –construction practices – drawbacks - EIA for Offshore structures.

Unit III	FORCES ON OFFSHORE STRUCTURES	9

Introduction-Permanent loads-operating loads. Environmental forces-wind force-wave force-current force-seaquake force-Ice force. Force due to tides - Marine growth - Use of API RP 2A guidelines

Unit IV	SUBMARINE PIPELINES AND RISERS	9

Pipeline elements-types of pipelines-laying method-materials. Pipe wall thickness verification. Pipeline stability. Design using DNV 81 code.

Unit V	ACCIDENTAL LOADS AND CORROSION	9

Fire, Blast and Collision- Behaviour of steel at elevated temperature- Fire rating for Hydrocarbon fire, Blast Mitigation-Blast walls- Collision of boats and energy absorption - Corrosion- Corrosion mechanism- Types of corrosion- Offshore structure corrosion zones- Biological corrosion- Preventive measures of corrosion- Online corrosion monitoring- Corrosion fatigue

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the offshore environment and technical terms associated with it.	**Understand**
CO.2	Evaluate suitable offshore structures according to environmental conditions	**Evaluate**
CO.3	Investigate various types of forces acting on the offshore structures	**Analyze**
CO.4	Adapt appropriate codes to design the submarine pipelines	**Apply**
CO.5	Discuss about the accidental loads and corrosion on offshore structures	**Evaluate**
CO.6	Designof key elements of offshore structure**,** assessment and integrity management. Embrace the thinking of life-cycle structural engineering	**Create**

Text Books:

McClelland, B and Reifel, M. D., Planning and Design of fixed Offshore Platforms, Van Nostrand, 1986.

Reddy, D. V and Arockiasamy, M., Offshore Structures Vol.1 & 2, Kreiger Publ. Co.1991.

Reference Books:

Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.

Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.

B.C Gerwick, Jr. Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.

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21CEV805	PORT AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To have an overall knowledge of the design and construction of airport, docks, harbours and ports as a whole.
- To understand the function of different components of airports, docks and harbours.

Unit I	INTRODUCTION	9

Ports and harbors: Classification of ports & harbours – Port and harbor planning and layout – Meteorological, hydrographic and oceanographic data requirements and measurements for port and harbor design.

Unit II	PORT AND HARBOURLAYOUT OPERATIONS	9

Port and harbour layout for vessels navigation and cargo handling- port buildings, navigation channels –shore infrastructure and utilities, land reclamation – Dredging -equipment, navigation improvement, pipelines and cables

Unit III	DESIGN OF PORT	9

Types and classification of ports and harbours in India, Natural ports and manmade ports, major ports, minor ports; Design of port infrastructures with regards to cargo handling , cargo storage and integrated transport of goods.

Unit IV	DESIGN OF HARBOUR	9

Design harbour Infrastructures - design of break water - shore attached and offshore breakwaters design - harbour basin design, approach channel design, turning basin design, with regards to cargo and passenger terminals

Unit V	CONSTRUCTION ASPECTS AND SMART PORT	9

Planning and construction, expansion of existing jetties and renovation of port –Inland Port Infrastructure - Smart Port : Levels of transformation into a smart port, Artificial Intelligence and Machine Learning, Smart application for ports.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the classification of port and harbor and study about the data requirement and measurements for port and harbour structures.	**Understand**
CO.2	Evaluate layout operations for vessel navigation and cargo handling.	**Evaluate**
CO.3	Demonstrate the basic design of port layout	**Analyze**
CO.4	Design, plan and integrate port and harbour infrastructure.	**Create**
CO.5	Evaluate the construction, maintenance and renovation aspects of ports and understand the concept of Smart Port and Smart application for ports	**Evaluate**
CO.6	Apply the fundamental principles of wave hydrodynamics and port cargo handling	**Apply**

Text Books:

1. Bruun, Per. Port engineering: vol. 1. Harbor planning, breakwaters, and marine terminals.1989
2. A. D. Quinn, “Design and Construction of Port and Marine Structures”, McGraw-Hill Book Company, 2nd Edition, 1972
3. C. A. Thoresen, “Port Design- Guidelines and recommendations”, Tapir Publications, Edition 1, 1988.

Reference Books:

1. J. W. Gaythwaite, Van Nostrand , “Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels” 1990
2. Muir Wood, A.M., and Fleming. C.A., “Coastal Hydraulics Sea and Inland Port Structures”, 1st Edition, Hallstead Press, 2002.

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21CEV806	COASTAL HAZARDS AND MITIGATION	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To provide the students the knowledge of coastal environment and to determine the characteristics of waves.
- To provide the students the knowledge of wave transformation, sediment transport, coastal protection measures and coastal structure design.

Unit I	COASTAL ENVIRONMENT	9

Start Contents here Beaches - Coastal features - Coastal Zonation - EEZ -Inshore and Offshore Areas - Mean Sea level - Basics of Tides and Waves - Coastal Morphology.

Unit II	WAVES DYNAMICS	9

Basics of waves - Classification - Wave Theory - Physical Characteristics of different types of waves - Linear Wave Theory - Wave celerity - Velocities -Accelerations - Displacements - Wave dynamics in shallow and deep water conditions.

Unit III	NEARSHORE WAVE TRANSFORMATION	9

Shoaling, refraction, diffraction and breaking– Interaction currents and waves- near shore currents-wave run-up and overtopping

Unit IV	SEDIMENT DYNAMICS AND TRANSPORT	9

Introduction to sediments, Sediment Analysis, types and sizes of sediments, sedimentation processes, sediment Supply & movement - Cross-shore sediment transport - Long shore sediment transport - Shoreline Changes - Shoreline Evolution - Erosion & Accretion.

Unit V	SHORE PROTECTION	9

Design of shore defense structures; Hard Engineering measures - Sea walls, Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures – Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation, Bioshields - Case studies

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic concepts of coastal environment.	**Understand**
CO.2	Evaluate sea state parameters (wave height, wave period, water levels) in shallow and deep water conditions.	**Evaluate**
CO.3	Design methods for coastal structures, shore protection, ports, waterways, and other coastal facilities.	**Create**
CO.4	Analysis the sediment and its transport processes.	**Analyze**
CO.5	Evaluate measures to protect beaches from erosion due to waves and currents	**Evaluate**
CO.6	Apply the data analysis, and synthesis of data and information from different sources with contemporary techniques and technologies.	**Apply**

Text Books:

1. Kamphuis, J.W., Introduction to coastal engineering and management, 2000
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice- Hall, Inc., Englewood Cliffs, New Jersey, 1994.
3. Mani J.S, “Coastal Engineering book”, PHI Publishing Company, 2nd Edition, 2021.

Reference Books:

1. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, Inc., New York, 1978.
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, NewYork, 1978.
3. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC,2006.

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21CEV807	COASTAL ZONE MANAGEMENT AND REMOTE SENSING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To be able to “see” the features and components of the coastal zone.
- To assess the various living and non-living resources
- To understand the need for coastal zone management and to develop an ICM plan.
- To provide the coastal and oceanographic applications of satellite remote sensing.

Unit I	COASTAL ZONE	9

SCoastal Zone – Beach Profile – Surf Zone – Off Shore – Coastal Waters – Coastal sediments - Estuaries– Wetlands and Lagoons – Coastal dunes – Coastal Geomorphology. tart Contents here

Unit II	COASTAL RESOURCES	9

Types and functions of coastal and marine resources – Renewable and Non-Renewable resources – Living marine resources and Nonliving marine resources – Marine minerals-Placer deposits – Hydrocarbon deposits – Polymetallic nodules.

Unit III	COASTAL ECOSYSTEM	9

Marine ecosystem: Mangroves – Seagrass – Seaweeds - Coral reef – Large marine ecosystem - Climate effects on living marine resources- Biological monitoring of marine ecosystem- Human impacts on marine ecosystem.

Unit IV	COASTAL REGULATIONS	9

Introduction- What is ICM- Developing an ICM framework- Principles-Goals-defining boundaries – Coastal Regulation Zones (CRZ) for main land and Islands –Environmental Law and policy.

Unit V	REMOTE SENSING IN COASTAL ZONE MANAGEMENT	9

Sensors and Platforms used for coastal application –Mapping of Coral Reefs, Macroalgae, Mangrove and Wetlands – Coastal Landuse / Land Cover Mapping – Coastal Regulation Zone Mapping – Case studies.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the science and basic of Coastal zone.	**Understand**
CO.2	Assess the living marine resources and non-living marine resources.	**Analyze**
CO.3	Evaluate importance of different ecosystem available in coastal and marine environment.	**Evaluate**
CO.4	Analyze the coastal regulations for mainland and islands.	**Analyze**
CO.5	Apply acquire knowledge about various satellites	**Apply**
CO.6	Apply the sensors used for marine and coastal environment model.	**Apply**

Text Books:

1. Richard Sylvester, “Coastal Engineering, Volume I And II”, Elseiner Scientific Publishing Co., 1999
2. NCSCM straigies and guide line for National implementation of Integrated Coastal zone management, 2013
3. Ramesh R and Purvaja R , E-learning module on ICZM for UNESCO-HE,TheNetheralands,2006

Reference Books:

1. Dwivedi,S.N., Natarajan,R And Ramachandran,S., “Coastal Zone Management In Tamilnadu”, Madras, 1991
2. David R. Green, Stephen D. King; Coastal and Marine Geo-Information Systems: Applying the Technology to the Environment, Springer, 2003

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21CEVG51	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To develop an understanding of tangible ways to improve the economic, social, and environmental performance of urban infrastructure across the design, construction.
- To discuss how sustainability outcomes can be improved in particular forms of infrastructure that align to specific global and national best practice principles.

Unit I	SUSTAINABLE DEVELOPMENT GOALS	9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian – Infrastructure Project finance – Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

Unit II	SUSTAINABLE INFRASTRUCTURE PLANNING	9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

Unit III	SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES	9

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

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Unit IV	SUSTAINABLE CONSTRUCTION MATERIALS	9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility – Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization – Green procurement and green distribution - Analysis framework for reuse and recycling – Typical.constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations – Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC – Case studies.

Unit V	SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS	9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. – Use of Emerging Technologies – IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the environment sustainability goals at global and Indian scenario.	**Understand**
CO.2	Evaluate risks in development of projects and suggest mitigation measures.	**Evaluate**
CO.3	Analyze a range of factors that drive good outcomes in infrastructure sustainability with a focus on responding to climate change.	**Analyze**
CO.4	Evaluate Life Cycle Analysis and life cycle cost of construction materials.	**Evaluate**
CO.5	Evaluate the new technologies for maintenance of infrastructure projects.	**Evaluate**
CO.6	Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.	**Apply**

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Text Books:
1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016
4. New Building Materials and Construction World magazine.
Reference Books:
1. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
3. New Building Materials and Construction World magazine.

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21CEVG52	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable
- agricultural systems for a changing world.

Unit I	AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS	9

Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes – Ecological services and agriculture - Problems associated with industrial agriculture/food systems – Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

Unit II	SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT	9

Soil health definition - Factors to consider (physical, chemical and biological) - Composition ofhealthy soils - Soil erosion and possible control measures - Techniques to build healthy soil -Management practices for improving soil nutrient - Ecologically sustainable strategies for pest anddisease control.

Unit III	WATER MANAGEMENT	9

Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use.

Unit IV	ENERGY AND WASTE MANAGEMENT	9

Types and sources of agricultural wastes - Composition of agricultural wastes – Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture.

Unit V	EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS	9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the concepts, principles and advantages of sustainableagriculture.	**Understand**
CO.2	Evaluate the sustainable ways in managing soil health, nutrients, pests and diseases.	**Evaluate**
CO.3	Analyze suggest the ways to optimize the use of water in agriculture to promote an ecological use of.	**Analyze**
CO.4	Develop energy and waste management plans for promoting sustainable agriculture in non-sustainablefarming areas	**Apply**
CO.5	Assess an ecosystem for its level of sustainability and prescribe ways of converting to asustainable system through the redesign of a conventional agroecosystem	**Evaluate**
CO.6	Apply the farming techniques for sustainable food production model	**Apply**

Text Books:

1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020.
2. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020.
3. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

Reference Books:

1. Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016.
2. Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021.
3. Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014.

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21CEVG53	SUSTAINABLE BIO MATERIALS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.
- To learn about Fundamentals aspects of Biopolymers and their applications

Unit I	INTRODUCTION TO BIOMATERIALS	9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

Unit II	BIO POLYMERS	9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene - Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin-Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

Unit III	BIO CERAMICS AND BIOCOMPOSITES	9

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites- Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

Unit IV	METALS AS BIOMATERIALS	9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

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Unit V	NANOBIOMATERIALS	9

Meatllicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor**-** Bioimaging/Molecular Imaging**-** challenges and future perspective.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Describe biomaterials, classifications, their properties, performance specification and biological applications	Understand
CO.2	Evaluate important Bioceramics and Biocomposite materials	Evaluate
CO.3	Apply the knowledge of biomaterials to judge which material/implant should be used for what kind of application according to nature of diseased and ill area of the body	Apply
CO.4	Decide the testing procedure for specific biomaterial/implant and evaluate the response of biomaterial/Implant to Human body	Apply
CO.5	Analyze methods to modify surfaces of biomaterials and choose material for sustainable development.	Analyze
CO.6	Analyze the biocompatibility and toxicological screening of biomaterials	Analyze

Text Books:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood

Reference Books:

1. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

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2. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

3. Leopoido Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.

IS Codes: (If necessary for your course)

1. IS: 800 – 2007, Code of Practice for general construction in steel, BIS, New Delhi
2. SP 6 (1) – Structural steel sections
3. IS 875 (1-5) - 1987 Code of practice for Design Loads (Other than Earthquake) for Buildings and Structures, BIS
4. IS 816 :1969 - Code of practice for Metal Arc Welding for general Construction in Mild Steel, BIS
5. IS: 808 – 1989 Dimensions For Hot Rolled Steel Beam, Column, Channel and Angle Sections.

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21CEVG54	MATERIALS FOR ENERGY SUSTAINABILITY	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To familiarize the students about the challenges and demands of energy sustainability
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell
- To enable students to appreciate novel materials and their usage in photovoltaic application
- To introduce students to the basic principles of various types Super capacitors and the materials used.

Unit I	SUSTAINABLE ENERGY SOURCES	9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

Unit II	ELECTROCHEMICAL DEVICES	9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel MetalHydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

Unit III	FUEL CELLS	9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

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Unit IV	PHOTOVOLTAICS	9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensionalGraphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine

Unit V	SUPERCAPACITORS	9

Super capacitor –types of super capacitors (electrostatic double-layer capacitors, pseudo capacitor sand hybrid capacitors) - design of super capacitor-three and two electrode cell-parameters of super capacitor- Faradaic and non - Faradaic capacitance – electrode materials (transition metaloxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noblemetal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbonfibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite conductive polypyrrole hydrogels – Different types of nano composites for the SC electrodes(carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	understand the principles of different electrochemical devices	Understand
CO.2	.Analyze acquire knowledge about energy sustainability.	Analyze
CO.3	Apply knowledge of the relationship between material properties and their suitability for energy-related applications	Apply
CO.4	Apply knowledge on different types of supercapacitors and the performance of various materials	Apply
CO.5	Analyze scientific literature related to energy materials and sustainability.	Analyze
CO.6	Evaluate the basic principles and concepts of materials science and engineering related to energy sustainability.	Evaluate

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Text Books:
1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
Reference Books:
1. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological a. applications, Kluwer Academic / Plenum publishers, New York, 1999.
2. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002
3. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia
4. Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
5. Recent advances, practical challenges, and perspectives of intermediate temperature solid
6. oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and
6. VenkataramanThangadurai, J. Mater. Chem. A, 2022.
7. Review of next generation photovoltaic solar cell technology and comparative materialistic
8. development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.
9. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological a. applications, Kluwer Academic / Plenum publishers, New York, 1999.

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21CEVG55	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Learning Objectives:

To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.

To provide green engineering solutions to energy demand, reduced energy footprint.

Unit I	PRINCIPLES OF GREEN CHEMISTRY	9

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

Unit II	POLLUTION TYPES	9

Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

Unit III	GREEN REAGENTS AND GREEN SYNTHESIS	9

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

Unit IV	DESIGNING GREEN PROCESSES	9

Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

Unit V	GREEN NANOTECHNOLOGY	9

Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basic design principles of green engineering and technology	Understand
CO.2	Apply the basic concept to identify pollution types using hazardous chemicals and solvents	Apply
CO.3	Apply advance green reagents and synthesis processes and products to make them green and safe.	Apply
CO.4	Analyse the design processes and products using green technology	Analyze
CO.5	Choose the appropriate green technology for water treatment, renewable energy materials for safe design processing	Analyze
CO.6	Investigate the nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology for current scenario	Analyze/ Mini Project

Text Books:

1. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
2. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.

Reference Books:

1. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications, 2008.
2. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017

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21CEVG56	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To introduce the students to conceive knowledge about the sampling methods for the quality monitoring for Air, Water and Soil.
- The course will also emphasize environmental investigative techniques, instrument selection, and quality control, including documentation, calibration, and sample management.

Unit I	Introduction to EQM	9

Definition of Environment - Objectives and functions of monitoring-Environmental Indicators - Link between source/environment/receptor - Exposure; Health effects; Toxicology - fate and transport of pollutants

Unit II	Quality control and Quality Assurance	9

Quality Parameters for environmental water, air and soil - Monitoring of environmental parameters - definition and synthesis of a monitoring – sampling - analysis method – Selection of monitoring sites-Types of monitoring program - Sampling requirements- Sampling methods – Preservation of samples - Quality Assurance and quality control (QA/QC)

Unit III	Water Quality Monitoring	9

Water quality guidelines – Quality indicators - Monitoring of quality indicators – Water quality monitoring programs – In situ and Ex situ studies – Structure of monitoring report for water quality – Rehabilitation and Sustainable usage.

Unit IV	Air and Soil Quality Monitoring	9

Air quality guidelines – Air quality monitoring programs – Emission control– Indoor and outdoor monitoring - Soil contaminants – Rehabilitation studies - Soil remediation – Barrier system – Physico chemical methods – Biological methods – Rehabilitation studies.

Unit V	Advanced monitoring system	9

Environmental Information system (ENVIS) – Real time monitoring system with GIS and Remote sensing – Sensors and IoT based techniques – Case Studies.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Comprehend the importance of quality monitoring on society and ecosystem by stressing on quality practices.	Understand
CO.2	Evaluate the nature of exposure, health effects due to transport of toxicants.	Evaluate
CO.3	Identify the contaminants, monitor them and treat them with suitable technology.	Apply
CO.4	Apply the concepts of engineering with advanced technologies to select sampling sites, collect samples and forecast soil, water and air quality.	Apply
CO.5	Carry out sample collection, preserve them, analyze the collected samples and plan suitable monitoring system with advanced software.	Analyze
CO.6	Prepare reports for real time monitored data and suggest possible remediation and rehabilitation measures. .	Analyze

Text Books:

1. FR Burden, Alex Guenther, Ian McKelvie, Environmental Monitoring Handbook, Tata McGraw-Hill Publishing Company Limited,2002.
2. Ragazzi, Marco, Air quality monitoring, measuring and modeling environmental hazards, Apple Academic Press (2017)
3. Young J. Kim, Advanced Environmental Monitoring, Springer, 2008.

Reference Books:

1. IS:5182 , Methods for measurements of air pollution(Part- I,II,IV,V,X).
2. Guidelines on the Shared Environmental Information System reporting mechanism, United Nations Economic Commission for Europe, 2020.

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21CEVG57	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To create awareness on the energy scenario of India with respect to world
- To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
- Familiarisation on the concept of sustainable development and its benefits
- Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development

Unit I	ENERGY SCENARIO	9

Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security Start Contents here

Unit II	ENERGY AND ENVIRONMENT	9

Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

Unit III	SUSTAINABLE DEVELOPMENT	9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG) - Social development: Poverty, conceptual issues and measures, impact of poverty. Globalization and Economic growth - Economic development: Economic inequalities, Income and growth.

Unit IV	RENEWABLE ENERGY TECHNOLOGY	9

Renewable Energy – Sources and Potential – Technologies for harnessing from Solar, Wind, Hydro, Biomass and Oceans – Principle of operation, relative merits and demerits

Unit V	ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	9

National & State Energy Policy - National solar mission - Framework of Central Electricity Authority - National Hydrogen Mission - Energy and climate policy - State Energy Action Plan, RE integration, Road map for ethanol blending, Energy Efficiency and Energy Mix

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the world and Indian energy scenario	**Understand**
CO.2	Analyze energy projects, its impact on environment and suggest control strategies	**Analyze**
CO.3	Evaluate the need of Sustainable development and its impact on human resource development	**Evaluate**
CO.4	Evaluate renewable energy technologies for sustainable development	**Evaluate**
CO.5	Apply Fathom Energy policies and planning for sustainable development	**Apply**
CO.6	Create Road map for ethanol blending, Energy Efficiency and Energy Mix model	**Apply**

Text Books:

1. M.H. Fulekar,Bhawana Pathak, R K Kale,"Environment and Sustainable Development" Springer,2016
2. Twidell, J.W. & Weir A., "Renewable Energy Resources", EFNSpon Ltd., UK, 2015.
3. Robert Ristirer and Jack P. Kraushaar, "Energy and the environment", Willey, 2005.

Reference Books:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012
2. Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
3. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
4. https://www.niti.gov.in/verticals/energy

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21CEVG58	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
- To create awareness on energy audit and its impacts
- To acquaint the techniques adopted for performance evaluation of thermal utilities
- To familiarise on the procedures adopted for performance evaluation of electrical utilities
- To learn the concept of sustainable development and the implication of energy usage

Unit I	ENERGY AND ENVIRONMENT	9

Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP Start Contents here

Unit II	ENERGY AUDITING	9

Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

Unit III	ENERGY EFFICIENCY IN THERMAL UTILITIES	9

Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

Unit IV	ENERGY CONSERVTION IN ELECTRICAL UTILITIES	9

Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

Unit V	SUSTAINABLE DEVELOPMENT	9

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty,

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the prevailing energy scenario	**Understand**
CO.2	Evaluate Familiarise on energy audits and its relevance	**Evaluate**
CO.3	Apply the concept of energy audit on thermal utilities	**Apply**
CO.4	Analyze Employ relevant techniques for energy improvement in electrical utilities	**Analyze**
CO.5	Evaluate Sustainable development on human resource development	**Evaluate**
CO.6	Apply Sustainable impact on human resource development	**Apply**

Text Books:

1. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, “Energy and the Environment”, 4th Edition,Wiley,2022
2. Pratap Bhattacharyya, “Climate Change and Greenhouse Gas Emission”, New India Publishing Agency-Nipa,2020
3. Matthew John Franchetti , Defne Apul “Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies” CRC Press,2012

Reference Books:

1. M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016
2. Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
3. Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.
4. W.R. Murphy and G. McKay “Energy Management” Butterworths, London 1987
5. Eastop.T.D& Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific &Technical, ISBN-0-582-03184, 1990

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Open Electives

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21UCE971	DEVELOPMENT OF SMARTCITIES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVE:

- Tohelptheleanerstounderstandthe conceptsofsmartcity and to introducethestudentsaboutapplicationoftechnologiesinsmartcities

Unit I	INTRODUCTION	9

Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission

Unit II	SMART PHYSICAL INFRASTRUCTURE	9

Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc

Unit III	SUSTAINABILITY AND SMART PLANNING	9

Relationship Between Sustainability and Smart planning - Place making project guidelines- Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Services;

Unit IV	APPLICATION OF TECHNOLOGIES IN SMART CITIES	9

Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities

Unit V	SMART CITIES PROJECT MANAGEMENT	9

Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the basics of Urbanisation and the role of smart cities	Understand
CO.2	Analyze implementation of smart physical infrastructure	Analyze
CO.3	Evaluate the role of smart planning for sustainable development	Evaluate
CO.4	Evaluate the knowledge of Technologies in Smart City planning	Evaluate
CO.5	Apply the case studies of smart city projects.	Apply
CO.6	Apply the case studies of Risk Management.	Apply

Text Books:

1.P Sharma , “Sustainable Smart cities in India, Challenges and Future Perspectives”, Springer Link, 2017

2.Sameer Sharma,“Smart Cities Unbounded- Ideas and Practice of Smart Cities in India”, Bloomsbury India, 2018.

Reference Books:

1.Binti Singh, ManojParmar, “Smart City in India Urban Laboratory, Paradigm or Trajectory? Routledge India,2019

2.https://smartcities.gov.in/guidelines#block-habikon-content

3.https://smartnet.niua.org/learn/library

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21UCE972	REMOTE SENSING AND GIS APPLICATIONS	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Tostudythe basicsofEMRanditsinteraction withatmospheric windows
- Toimparttheknowledge onbasics ofplatformsandsensors.
- Toprovidetheknowledge oninterpretationofimages
- Togetintroducedonbasicconcepts ofGIS.
- Tounderstandtheprocessofstorageand analysisofvariousdata.

Unit I	EMRANDITSINTERACTIONWITHATMOSPHERE	9

Definitionofremotesensinganditscomponents–Electromagneticspectrum–wavelengthregionsimportant to remote sensing – Wave theory, Particle theory– Atmospheric scattering, absorption –Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics ofwater,vegetationandsoil

Unit II	PLATFORMS ANDSENSORS	9

Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Activesensors-resolution concept – Pay load description of important Earth Resources and Meteorologicalsatellites–AirborneandspaceborneTIRandmicrowavesensors.

Unit III	IMAGEINTERPRETATIONANDANALYSIS	9

Types of Data Products – types of image interpretation – basic elements of image interpretation-visual interpretation keys – Digital Image Processing – Pre-processing – image enhancementtechniques–multispectralimageclassification–Supervisedandunsupervised.

Unit IV	GEOGRAPHIC INFORMATION SYSTEM	9

Introduction–Maps–projections–types–mapanalysis–GISdefinition–basiccomponentsofGIS – standard GIS software – Data type – Spatial and non-spatial data – measurement scales – DataBaseManagementSystems(DBMS).

Unit V	DATAENTRY,STORAGEAND ANALYSIS	9

Datamodels–vectorandrasterdata–datacompression–datainputbydigitizationandscanning–attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – LandInformationsystem

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the Electromagnetic spectrum and the interaction changes in the atmosphere for various objects in the earth surface.	Understand
CO.2	Analyze the spectral signatures for various earth futures in visible, NIR, TIR region.	Analyze
CO.3	Evaluate the End member extraction, preprocessing, post processing and classification of optical imageries with accuracy assessment.	Evaluate
CO.4	Analyze the variation between active and passive sensors and incorporate the active sensor processing methods.	Analyze
CO.5	Evaluate the data models and its interpolation techniques	Evaluate
CO.6	Apply the vector model and develop the DBMS for various projects	Apply

TEXTBOOKS:

1. SatheeshGopi,—AdvancedSurveying‖,PearsonEducation,2007.
2. DuggalR.K,–SurveyingⅡVol.IandII,TataMcGraw HillPublishingCompany Ltd.,New Delhi,2004.

Reference Books:

1. BannisterA andRaymondS,–SurveyingⅡ,AddisonWesley Longman ltd,England,2006.
2. Anderson,J.M.andMikhail,E.M.,—Surveying:TheoryandPractice‖,McGrawHill,1998
3. Schofield,W.andBreachM.,—EngineeringSurveying‖,6thEd.,Butterworth-Heineman,2007
4. Bossler,J.D.,—ManualofGeospatialScienceandTechnology‖,TaylorandFrancis,2002.
5. Burrough,P.A.andMcDonnell,R.A.,—PrinciplesofGeographicInformationSystem‖,OxfordUniversity Press,2000.

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21UCE973	DISASTERMANAGEMENT AND MITIGATION	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- ToimpartknowledgeofthebasicconceptsinDisasterManagement,TypesandCategoriesof Disasters the ChallengesposedbyDisastersand theImpactsofDisasters
- Toprovideanunderstandingoftheapproachesto disaster riskreduction
- Tocreate awarenessofthe disaster management Policiesand Legislationin India

Unit I	INTRODUCTION ANDTYPES OF DISASTERS	9

Definition: Disaster, Hazard, Vulnerability, Resilience risks severity, frequency and details, capacity,impact,prevention,mitigation.Geologicaldisaster:Earthquakes,landslides,tsunami,mining);Hydro-MeteorologicalDisasters(floods,cyclones,lightning,thunder-storms,hailstorms,avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forestfire); Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters(buildingcollapse,rural andurban fire,transportation accidents,nuclearradiation,radiological,chemicalsandbiologicaldisasters)-mountain andcoastalareas-ecologicalfragility.

Unit II	DISASTER IMPACTS	9

Impacts (including social, economic, political, ecological, environmental, health, psycho-social, etc.)Differential impacts: urban disasters, pandemics, complex emergencies, Climate change - hazardlocations- globalandnationaldisastertrends.

Unit III	DISASTER RISKREDUCTION (DRR)	9

Disaster management cycle - its Phases, Culture of safety, prevention, mitigation and preparednesscommunitybasedDRR,Structural-non-structuralmeasures—riskanalysis,vulnerabilityandcapacityassessment;earlywarningsystems,Post-disasterenvironmentalresponse(water,sanitation, food safety, waste management, disease control, security, communications); Roles andresponsibilities ofcommunity, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs) and otherstake-holders.

Unit IV	DISASTERSAND DEVELOPMENT	9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects and environmentalmodificationssuchasdams,changesinLand-use,urbanization,etc.sustainableandenvironmentalfriendly recovery;reconstructionanddevelopmentmethods.

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Unit V	DISASTERRISK MANAGEMENTIN INDIA	9
Disaster(Hazardandvulnerability)Profileof India–MegaDisastersof IndiaandLessonsLearnt,Disaster Management Act 2005 – Institutional and Financial Mechanism, National Policy on DisasterManagement, National Guidelines and Plans on Disaster Management; Role of Government (local,stateandnational),Non-GovernmentandInter-GovernmentalAgencies		
		TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understanddifferenttypesofdisasters,causes andtheirimpactonenvironmentandsociety	Understand
CO.2	Evaluatevulnerabilityand variousmethodsofrisk reductionmeasuresaswell as mitigation.	Evaluate
CO.3	EvaluatetheimpactofdevelopmentprojectsinIndianScenarioanduseappropriatet echnologyandresources	Evaluate
CO.4	Analyze the various vulnerability profiles of disaster and its mitigation activities.	Analyze
CO.5	Analyze the various recovering and restructure processing in natural and manmade disaster	Analyze
CO.6	Carryoutfieldworksrelated to disaster management	Apply

TEXTBOOKS:

1. SinghalJ.P.—DisasterManagement‖,LaxmiPublications,2010.
2. TusharBhattacharya,—DisasterScienceandManagement‖,McGrawHillIndiaEducationPvt.Ltd.,2012.

Reference Books:

1. DisasterManagementGuidelines‖.GOI-UNDPDisasterRiskReductionProgramme,2012.
2. DisasterMedicalSystemsGuidelines‖.EmergencyMedicalServicesAuthority,StateofCalifornia,EMSAno. 214,June 2003.
3. NationalDisasterManagementAuthority‖,GovernmentofIndia,NewDelhi,2005
4. NationalDisasterManagementPolicy‖,GovernmentofIndia,,2009.

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21UCE974	AIRPOLLUTIONANDCONTROLENGINEERING	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Toimpartknowledgeontheprincipleanddesignofcontrolof Indoor/particulate/gaseousairpollutantand itsemergingtrends.
- To giveanoverviewoffactorsaffectingselectionofcontrolequipmentforparticulateandgaseouscontaminants.

Unit I	INTRODUCTION	9

Structure and composition of Atmosphere — Definition, Scope and Scales of Air Pollution —Sources and classification of air pollutants and their effect on human health, vegetation, animals,property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Ambient andstacksamplingandAnalysisofParticulateandGaseousPollutants.

Unit II	METEOROLOGY	9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Windprofilesandstackplumepatterns-AtmosphericDiffusionTheories–Dispersionmodels,Plumerise.

Unit III	CONTROLOFPARTICULATECONTAMINANTS	9

FactorsaffectingSelectionofControlEquipment–GasParticleInteraction–Workingprinciple,Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters,ParticulateScrubbers,ElectrostaticPrecipitators–OperationalConsiderations.

Unit IV	CONTROLOFGASEOUS CONTAMINANTS	9

Factors affecting Selection of Control Equipment — Working principle, Design and performanceequations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters —ProcesscontrolandMonitoring-OperationalConsiderations.

Unit V	INDOORAIRQUALITY MANAGEMENT	9

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollutionanditscontrol-SourcesandEffectsofNoisePollution–Measurement–Standards–ControlandPreventivemeasures.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand thevarious sourcesofairpollutantsandtheireffectsonhumanbeings,materialsandvegetation.	Understand
CO.2	Evaluate theprocesses, approaches, anddevices used tocontrol airpollution.	Evaluate
CO.3	Applytheknowledgetocontrol ofparticulateandgaseouscontaminantsintheenvironment.	Apply
CO.4	Analyzethecontrol and preventive measuresofnoise pollution.	Analyze
CO.5	Applytheappropriatemethodto improve indoor air quality.	Apply
CO.6	Interpretationofairpollutionproblemsinvariousareasandairqualitydatatoprovidevalidconclusionfor controlofairpollution	Apply

TEXTBOOKS:

1. LawrenceK.Wang,NormanC.Pareira,YungTseHung,AirPollutionControlEngineering,Tokyo,2004
2. Anjaneyulu.Y,„AirPollutionandControlTechnologies‟,AlliedPublishers(P)Ltd.,India2002.

REFERENCE BOOKS:

1. DavidH.F.Liu,BelaG.Liptak„AirPollution‟,LweisPublishers,2000.
2. ArthurC.Stern,„AirPollution(Vol.I–Vol.VIII)‟,AcademicPress,2006.
3. WayneT.Davis,„AirPollutionEngineeringManual‟,JohnWiley&Sons,Inc.,2000.
4. Noelde Nevers,AirPollution ControlEngineering,Mc GrawHill,NewYork,1995

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21UCE975	ENVIRONMENTALANDSOCIALIMPACTASSESSMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Toimparttheknowledgeandskillstoidentify,assessandmitigatetheenvironmentalandsocialimpactsofdevelopmentalprojects.
- Toprovidetheconceptsofenvironmental assessmentand environmentalaudit.
- Togiveanoverviewofcasestudiespertainingtodevelopmental projects.

Unit I	INTRODUCTION	9

Impacts of Development on Environment – Sustainable Development Goals - Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –legal and regulatory aspects in India –– EIA Process- Screening and Scoping– setting- Analysis mitigation.

Unit II	ENVIRONMENTALASSESSMENT	9

Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy,flora and fauna - Matrices — Networks — Checklist Methods - Mathematical models for Impactprediction—Analysisofalternatives.

Unit III	ENVIRONMENTALMANAGEMENTPLAN	9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan — EIA Report Preparation — Review of EIA Reports — EnvironmentalClearance–EnvironmentalAudit–ISO14001

Unit IV	SOCIOECONOMICASSESSMENT	9

BaselinemonitoringofSocioeconomicenvironment–IdentificationofProjectAffectedPersonal

– Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – CostbenefitAnalysis-PublicConsultation

Unit V	CASE STUDIES	9

EIA case studies pertaining to Infrastructure Projects — Real Estate Development - Roads andBridges — Mass Rapid Transport Systems - Ports and Harbor — Airports - Dams and Irrigationprojects - Power plants — Wastewater Treatment Plants- Waste Processing and Disposalfacilities-MiningProjects.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understandtheobjectives,capability,andlimitationsof environmentalimpactassessment	Understand
CO.2	Analyzethemethodologiesandlegalaspectsof environmentalimpactassessment	Analyze
CO.3	Evaluate thepreparationand reviewofEIAreports	Evaluate
CO.4	Evaluatetheimpactoftheconstructionprojectsontheenvironmentandsuggestrehabilitationmeasures	Evaluate
CO.5	Rehabilitation and Resettlement Plan of the Economic valuation of Environmental impacts	Apply
CO.6	Do acasestudy onEnvironment ImpactAssessmentpertainingtoInfrastructure Projects.	Apply

TEXTBOOKS:

1. Canter,R.L(1997).Environmental impactAssessment,2ndEdition, McGrawHillInc., NewDelhi.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu (1997).Environmental Impact Assessment for Developing Countries in Asia. Volume 1 – Overview, AsianDevelopment Bank

Reference Books:

1. JohnGlasson,RikiTherivel,AndrewChadwick(2005), "IntroductiontoEnvironmentalImpactAssessment",Routledge Publishers
2. BarrySadlerandMaryMcCabe(2002),"EnvironmentalImpactAssessmentTrainingResourceManual",UnitedNationsEnvironmentProgramme.
3. Anjaneyalu,Y.Vallimanickam,"EnvironmentalImpactAssessmentMethodologies",BSPublications,India.

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21UCE976	ROADSAFETY	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Exposure on thetraffic engineeringbasics &statisticsmethodstoanalysisthetrafficsafety.
- Knowledge on theinfluencingfactorsand causesofaccidents.
- Idea about theroleof roadsafetyinplanninganddesignoftheurban infrastructure.
- Exposure about thetraffic managementsystemsforimprovingtheroadsafety.

Unit I	Fundamentals ofTraffic Engineering	9

Characteristics of Motor vehicle Traffic, Highway Capacity- Applications of Traffic ControlDevices-TrafficDesignofParkingFacilities-typeofsurveys–Traffic survey – speed, journey time and delay surveys, classified volume count survey, vehicle occupancy survey.

Unit II	Accident Investigations and RiskManagement	9

Accident Data-Condition and Collision Diagram-Causes and Remedies-Traffic ManagementMeasures-AssessmentofRoadSafety,Methods to IdentifyandPrioritizeHazardousLocationsandElements,CrashesandCountermeasures,SafetyDesign-AccidentReconstruction.

Unit III	Road Safetyin Geometric Design	9

Road alignment-Cross section of roads and its elements-roaddesignandequipmentredesigningjunctions, -intersection improvements-reconstruction & rehabilitation, traffic control, concepts of vehicledesign&protectivedevices.

Unit IV	Urban infrastructureinRoad safety	9

Geometric design ofroads-significance ofhorizontal & vertical elements-Role and importanceofjunctions:atgradeandgradeseparatedintersections-roadsafetyinurbantransport,sustainablemodesand theirsafety.

Unit V	TrafficManagementSystemsforRoad Safety	9

Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process,Approach toSafety,RoadSafetyImprovementStrategies,ITS andSafety.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the fundamental components of road safety, including traffic management, road geometry, and the accident investigation approaches.	Understand
CO.2	Apply knowledge to improve road safety by incorporating the data and characteristics from traffic engineering and accident investigations.	Apply
CO.3	Apply knowledge on traffic control systems and safe road geometry approaches for enhanced road safety.	Apply
CO.4	Analyze vehicle and road user characteristics to identify appropriate measures for resolving traffic accidents.	Analyze
CO.5	Analyze and design the horizontal and vertical sectional elements of the road considering the safety conditions and Intelligent Transport System (ITS).	Analyze
CO.6	Apply knowledge to perform a road safety audit to evaluate the level of safety management in both urban and rural road infrastructure systems.	Apply

TEXTBOOKS:

1. TrafficEngineeringand TransportationPlanning–L.R.Kadiyali,KhannaPublishers
2. FundamentalsofTransportationEngineering–C.S.Papacostas,PrenticeHallIndia.
3. TransportationEngineering–AnIntroduction,C.Jotinkhisty,B.KentLall,McGrawHil,

ReferenceBooks:

1. IRC:119-2015:guidelinesfortrafficsafetybarriers.
2. ElvikRune, TheHandbookofRoad Safety Measures(2009-10-20).
3. S.SRandhawa, "TextbookofEnvironmentalEducationwithRoadSafetyandTrafficRules"(asperstandard adopted byUGC)PVBooks,2016.

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21UCE977	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Learning Objectives:

- Toimparttheknowledgeandskillstoidentifyandassessthewastestorage,collection,transfer, handlingand disposalmeasures.
- Toprovidetheknowledge onissuesofsolid wastemanagement.
- Togive anoverviewoflegislation andregulationsofsolid wastemanagement.

Unit I	INTRODUCTIONTOSOLIDWASTEMANAGEMENT	9

Need and objectives – waste management hierarchy – Functional elements – Environmental impact of mismanagement – solid waste: Sources, types, composition, quantities, physical, chemical and biological properties.

Unit II	STORAGE,COLLECTION &TRANSFER	9

General considerations for waste storage at source – factors affecting storage andcollection - collection services – collection system, equipments, time and frequency ofcollection – labour requirement - collection routes – preparation of master schedules -Need for transfer operation - – transfer stations – types: Transfer stations – selection oflocation,types&designrequirements,operation&maintenance.

Unit III	PROCESSING& DISPOSALOFMUNICIPAL SOLIDWASTE	9

Processing technologies: composting, incineration and pyrolysis. Energy recovery fromsolid waste – Bio-methanation.Disposal: Landfill and its introduction – Essentialcomponents – site selection – Land filling methods – Leachate analysis and landfill gasmanagement– treatmentanddisposal.Municipalsolidwastemanagementrules2016

Unit IV	BIOMEDICALWASTEMANAGEMET& HEALTHASPECTS	9

Biomedical waste:sourcesand generation— classificationofbiomedicalwaste—management technologies. Health Aspects: handling, processing, segregation, recovery,recycling and reuse of solid waste. Public involvement and participation in solid wastemanagementpractices.Biomedicalwastemanagementrules2016.

Unit V	INDUSTRIAL & E-WASTEMANAGEMENT	9

Industrial waste: sources — types — collection and disposal — control measures —recycling E-waste:sources–types–recycling–disposal.DangersofE-waste.E–WastemanagementRules2016.

TOTAL - 45 Periods

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Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understandthewastemanagementhierarchyandidentifyopportunitiestominimize solidwasteproduction.	Understand
CO.2	Evaluatethesuitablesitefor landfillandprocessingfacility.	Evaluate
CO.3	Carryoutphysicalandchemicalanalysisofmunicipalsolidwastesandapplythemfor amanagementsystemthatwillbesetup.	Analyze
CO.4	Analyze technical solid waste management options and imposed environmental legislation todeveloplegalandsafesolutions.	Analyze
CO.5	Prepare arouteoptimizationforasolid wastecollection andtransportsystem.	Apply
CO.6	Making model of health Aspects of handling, processing, segregation, recovery,recycling and reuse of solid waste	Apply

TEXTBOOKS:

1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt. Ltd,2018
2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management — ScienceandEngineering,Butterworth-Heinemann,2016

ReferenceBooks:

1. GeorgeTchobanoglous,HilaryTheisenandSamuelA,Vigil,—IntegratedSolidWasteManagement,Mc-GrawHillIndia,Firstedition,2015.
2. CPHEEO, —Manual on Municipal Solid waste management, Vol I, II and III, Central Public Healthand EnvironmentalEngineeringOrganisation ,GovernmentofIndia,NewDelhi,2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering- A GlobalPerspective,3rdEdition, CengageLearning,2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental ResourcesManagement,HazardouswasteManagement",Mc-
5. JohnPitchtel,Waste Management Practices,CRC Press, TaylorandFrancisGroup,2014.

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6. Gary C. Young, Municipal Solid Waste to Energy Conversion Processes: Economic, Technical,andRenewableComparisons,Wiley,2010.

21UCE978	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
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Course Learning Objectives:

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Unit I	COMPONENTS OF ENVIRONMENT	9

.Components – Water, air and land – Inter-relationship between components – Subcomponents; Ecosystem – Structure and functional components of ecosystem – Development and evolution of ecosystem – Energy flow and material cycling in ecosystem – Natural and manmade impacts on water, air and land; Environment and development – Concept of sustainable development

Unit II	SCIENCE OF ENVIRONMENT	9

Chemistry, Physics and biology of water, air and land; Stress on the Chemistry, Physics and Biology of water, air and land owing to the impacts; Environmental quality objective and goals – Policies on development projects and their impacts, with emphasis on the branch of engineering of the student.

Unit III	CURRENT ENVIRONMENTAL ISSUES9	9

Current Environmental issues at Country level – management of municipal sewage, municipal solid waste, Hazardous waste and Bio-medical waste – Air pollution due to industries and vehicles; Global issues – Biodiversity, Climatic change, and Ozone layer depletion

Unit IV	ENGINEERING INTERVENTIONS TO REDUCE THE ENVIRONMENTAL	9

Minimization of Stress – Principles of Physics, chemistry and biology in engineering interventions such as waste treatment – Flow sheets of engineering interventions relevant to the Engineering discipline of the student – Waste minimization techniques – Clean technology options – Standards of performance of the interventions

Unit V	TOOLS FOR ENVIRONMENTAL MANAGEMENT	9

Environmental impact assessment; Precautionary Principle and Polluter Pays Principle; Constitutional provisions, Legal and economic instruments in Environmental Management; Role of Non-government

organizations – Community participation environmental management works; International conventions and protocols; Pollution Control Boards and Pollution Control Acts.

TOTAL - 45 Periods

Course Outcomes:

After the successful completion of the course, Students will be able to,

COs	CO Statements	BT Levels
CO.1	Understand the necessity of sustainable development	Understand
CO.2	Frame environmental quality policies for development projects and assess their impacts	Apply
CO.3	Realize the importance of current environmental issues	Apply
CO.4	Have an elaborate knowledge about techniques of waste minimization	Analyze
CO.5	Analyze the social issues and various environmental acts.	Analyze
CO.6	Community participation environmental management works, cleaning techniques	Apply

TEXTBOOKS:

1. Gilbert M.Masters, —Introduction to Environmental Engineering and Science‖, Third Edition, Pearson Education, Upper saddle River, New Jersey, 2004.

2. Benny Joseph, —Environmental Science and Engineering‖, Tata Mc-Graw Hill, New Delhi, 2006.

Reference Books:

1. Miller T.G. Jr., —Environmental Science‖, Wadsworth Publishing Company, Belmont, California, 1996.

2. Anubha Kaushik, Kaushik C.P., —Environmental Science and Engineering‖, Third Edition, New Age International, New Delhi, 2009.

3. De A.K., —Environmental Chemistry‖, Wiley Eastern Ltd., New Delhi, 2001.

4. Trivedi R.K., Goel P.K., —Introduction to Air Pollution‖, Techno-Science Publications, Jaipur, 1995