KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E. CIVIL ENGINEERING

KCG College of Technology was founded in 1998 to fulfill the Founder-Chairman, Dr. KCG Verghese's vision of **"To Make Every Man a Success and No Man a Failure".** It is a Christian minority institution, affiliated to Anna University (Autonomous), Chennai and approved by AICTE, New Delhi.

VISION OF KCG

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building.

MISSION OF KCG

- Disseminate knowledge in a rigorous and intellectually stimulating environment.
- Facilitate socially responsive research, innovation and entrepreneurship.
- Foster holistic development and professional competency.
- Nurture the virtue of service and an ethical value system in the young minds.

VISION OF CIVIL ENGINEERING

The Department of Civil Engineering strives to become a competent academic centre for quality education in the areas of civil engineering and research and to produce professionally skillful civil engineers to meet the demands of the society.

MISSION OF CIVIL ENGINEERING

- Our vision is supported by our four-fold mission statement:
- Impart high quality education through an innovative teaching-learning process.
- Establish state-of-the-art infrastructure to facilitate skill development in cutting-edge technologies and research.
- Inculcate students with innovative thinking, ethical principles, leadership skills and entrepreneurial capabilities.
- Enhance the competency and knowledge of the faculty in the emerging areas of technology in the domain of civil engineering.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	Develop expertise in Civil Engineering to analyze, evaluate, and solve real-world challenges, ensuring career growth and success in public and private sectors.
PEO 2	Gain expertise in analyzing, designing, and evaluating complex Civil Engineering problems in infrastructure, preparing graduates for consultancy roles.
PEO 3	Innovate, design, and implement entrepreneurial solutions for society's infrastructure needs with technical, economic, and social feasibility.
PEO 4	Conduct research and apply modern tools to investigate and solve Civil Engineering problems effectively.
PEO 5	Collaborate in multidisciplinary teams to evaluate, develop, and advocate policies and advancements in Civil Engineering practices.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO 01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 02	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 03	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.
PO 04	Use research based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 05	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO 06	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.
PO 07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	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.
PO 11	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.

PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 01	**Knowledge of Civil Engineering discipline:** Demonstrate in-depth knowledge of Civil Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge.
PSO 02	**Critical analysis of Civil Engineering problems and innovation:** Critically analyze complex Civil Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.
PSO 03	**Conceptualization and evaluation of engineering solutions to Civil Engineering:** Issues Conceptualize and solve Civil Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio cultural factors

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CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23AD101	Programming in Python	ESC	3	0	0	3	3
4	23HS102	Heritage of Tamils	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
5	23PH111	Engineering Physics	BSC	3	0	2	5	4
6	23CY111	Engineering Chemistry	BSC	3	0	2	5	4
PRACTICALS								
7	23AD121	Python Programming Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication Skills Laboratory	HSMC	0	0	2	2	1
9	23HS122	General Clubs / Technical Clubs / NCC / NSS / Extension Activities	HSMC	0	0	2	2	1*
TOTAL				16	0	12	28	21

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER –II

Sl. No.	Course code	Course Title	Category	Periods Per Week L	T	P	Total Contact Periods	Credits
THEORY								
1	23HS201/ 23HS202	Professional English/ Foreign language	HSMC	3	0	0	3	3
2	23MA203	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	23PH201	Physics for Civil Engineering	BSC	3	0	0	3	3
4	23CE201	Building Materials	PCC	3	0	0	3	3
5	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
6	23EE282	Basic Electrical, Electronics and Instrumentation Engineering	ESC	2	0	2	4	3
7	23ME211	Engineering Graphics	ESC	3	0	2	5	4
PRACTICALS								
8	23ME221	Engineering Practices Laboratory	PCC	0	0	4	4	2
9	23CE221	Materials Testing Laboratory	PCC	0	0	4	4	2
10	23HS221	Soft Skills	EEC	0	0	2	2	1*
TOTAL				18	1	14	33	25

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-III

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA302	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2	23CE301	Engineering Mechanics	PCC	3	0	0	3	3
3	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
4	23CE311	Surveying	PCC	3	0	2	5	4
5	23CE312	Advanced Concrete Technology	PCC	3	0	2	5	4
6	23ME312	Fluid Mechanics and Hydraulic Machinery	PCC	3	0	2	5	4
PRACTICALS								
7	23CE321	Computer Aided Building Drawing Laboratory	PCC	0	0	4	4	2
8	23ES391	Presentation Skills	EEC	0	0	2	2	1*
TOTAL				18	1	12	31	24

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-IV

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA401	Optimization Techniques	BSC	3	1	0	4	4
2	23CE401	Transportation Engineering	PCC	3	0	0	3	3
3	23CE402	Water Supply and Waste Water Engineering	PCC	3	0	0	3	3
4		Department Elective 1	DEC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23CE411	Soil Mechanics	PCC	3	0	2	5	4
6	23CE412	Strength of Materials	PCC	3	0	2	5	4
PRACTICALS								
7	23CE421	Water and Waste Water Analysis Laboratory	PCC	0	0	4	4	2
8	23ES491	Aptitude and Logical Reasoning -1	EEC	0	0	2	2	*1
9	23CE422	In Plant Training	EEC	0	0	0	2	1
TOTAL				**18**	**1**	**12**	**31**	**24**

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-V

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23CE501	Design of Reinforced Concrete Elements	PCC	3	0	0	3	3
3	23CE502	Structural Analysis I	PCC	3	0	0	3	3
4	23CE503	Foundation Engineering	PCC	3	0	0	3	3
5		Department Elective 2	DEC	3	0	0	3	3
6		Open Elective 1 (Emerging Technology)	OEC	3	0	0	3	3
PRACTICALS								
7	23CE521	Computer Aided Design and Detailing Laboratory	PCC	0	0	4	4	2
8	23CE522	Survey Camp	PCC	0	0	4	4	2
9	23CE523	Design Project	EEC	0	0	4	4	2
10	23ES591	Aptitude and Logical Reasoning – 2	EEC	0	0	2	2	*1
TOTAL				**17**	**0**	**14**	**31**	**23**

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	credits
				L	T	P		
THEORY								
1	23CE601	Design of Steel Structures	PCC	3	0	0	3	3
2	23CE602	Structural Analysis II	PCC	3	0	0	3	3
3		Department Elective 3	DEC	3	0	0	3	3
4		Department Elective 4	DEC	3	0	0	3	3
5		Open Elective 2 (Management /Safety Courses)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23CE611	Environmental Science and Engineering	ESC	3	0	2	5	4
PRACTICALS								
7	23CE621	Project Work – Phase 1	EEC	0	0	4	4	2
8	23CE622	Technical Training	EEC	0	0	2	2	1
9	23CE623	Technical Seminar -1	ESC	0	0	2	2	1
TOTAL				**18**	**0**	**10**	**28**	**23**

SEMESTER -VII

Sl. No.	Course Code	Course Title	Category	periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Open Elective 3 (Management Courses)	OEC	3	0	0	3	3
2		Department Elective 5	DEC	3	0	0	3	3
3		Department Elective 6	DEC	3	0	0	3	3
4	23CE701	Comprehension	EEC	0	2	0	2	2
THEORY AND PRACTICALS								
5	23CE711	Estimation Costing and Valuation Engineering	PCC	3	0	2	5	4
PRACTICALS								
6	23CE721	Project Work – Phase 2	EEC	0	0	6	6	3
7	23CE722	Technical Seminar - 2	ESC	0	0	4	4	2
TOTAL				**14**	**0**	**12**	**26**	**20**

SEMESTER -VIII

Sl. No.	Course code	Course Title	Cate Gor y	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23CE821 / 23CE822	Capstone Project / Internship Cum Project	EEC	0	0	20	20	10
TOTAL				**0**	**0**	**20**	**20**	**10**

TOTALCREDITS: 170

DEPARTMENT ELECTIVE COURSES: VERTICALS

VERTICAL 1 : STRUCTURES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE031	Repair and Rehabilitation of Structures	DEC	3	0	0	3	3
2	23CE032	Dynamics and Earthquake Resistant Structures	DEC	3	0	0	3	3
3	23CE033	Pre-stressed Structures	DEC	3	0	0	3	3
4	23CE034	Prefabricated Structures	DEC	3	0	0	3	3
5	23CE035	Composite Structures	DEC	3	0	0	3	3
6	23CE036	Smart Materials and Smart Structures	DEC	3	0	0	3	3

VERTICAL 2 : GEOTECHNICAL

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE037	Geo-Environmental Engineering	DEC	3	0	0	3	3
2	23CE038	Ground Improvement Techniques	DEC	3	0	0	3	3
3	23CE039	Pile Foundation	DEC	3	0	0	3	3
4	23CE040	Tunneling Engineering	DEC	3	0	0	3	3
5	23CE041	Earth Retaining Structures	DEC	3	0	0	3	3
6	23CE042	Soil Dynamics and Machine Foundations	DEC	3	0	0	3	3

VERTICAL 3 : TRANSPORTATION & INFRASTRUCTURES

Sl. No.	Course Code	Course Title	Cate Gory	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE043	Intelligent Transport Systems	DEC	3	0	0	3	3
2	23CE044	Urban Planning and Development	DEC	3	0	0	3	3
3	23CE045	Transportation Planning Process	DEC	3	0	0	3	3
4	23CE046	Smart Cities	DEC	3	0	0	3	3
5	23CE047	Pavement Engineering	DEC	3	0	0	3	3
6	23CE048	Traffic Engineering and Management	DEC	3	0	0	3	3

VERTICAL 4 : WATER RESOURCES

Sl. No.	Course Code	Course Title	Cate Gory	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23CE049	Water Quality and Management	DEC	3	0	0	3	3
2	23CE050	Ground Water Engineering	DEC	3	0	0	3	3
3	23CE051	Watershed Conservation and Management	DEC	3	0	0	3	3
4	23CE052	Integrated Water Resources Management	DEC	3	0	0	3	3
5	23CE053	Hydrology and Irrigation Engineering	DEC	3	0	0	3	3
6	23CE054	Water Resources System Engineering	DEC	3	0	0	3	3

VERTICAL 5 : GEO INFORMATICS

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE055	Airborne and Terrestrial Laser Mapping	DEC	3	0	0	3	3
2	23CE056	Remote Sensing Concepts and Techniques	DEC	3	0	0	3	3
3	23CE057	Satellite Image Processing	DEC	3	0	0	3	3
4	23CE058	Cartography and GIS	DEC	3	0	0	3	3
5	23CE059	Photogrammetry	DEC	3	0	0	3	3
6	23CE060	Hydrographic Surveying	DEC	3	0	0	3	3

VERTICAL 6 : CONSTRUCTION TECHNIQUES

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE061	Formwork Engineering	DEC	3	0	0	3	3
2	23CE062	Sustainable Construction and Lean Construction	DEC	3	0	0	3	3
3	23CE063	Construction Planning and Scheduling	DEC	3	0	0	3	3
4	23CE064	Construction Techniques Equipment & Practices	DEC	3	0	0	3	3
5	23CE065	Energy Efficient Buildings	DEC	3	0	0	3	3
6	23CE066	Rainwater Harvesting	DEC	3	0	0	3	3

VERTICAL 7 : ENVIRONMENT

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE067	Climate Change Adaptation and Mitigation	DEC	3	0	0	3	3
2	23CE068	Air and Noise Pollution Control Engineering	DEC	3	0	0	3	3
3	23CE069	Environmental Impact Assessment	DEC	3	0	0	3	3
4	23CE070	Solid and Hazardous Waste Management	DEC	3	0	0	3	3
5	23CE071	Environmental Health and Safety	DEC	3	0	0	3	3
6	23CE072	Environmental Quality Monitoring	DEC	3	0	0	3	3

VERTICAL 8 : OCEAN ENGINEERING

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23CE073	Ocean Wave Dynamics	DEC	3	0	0	3	3
2	23CE074	Marine Geotechnical Engineering	DEC	3	0	0	3	3
3	23CE075	Coastal Engineering	DEC	3	0	0	3	3
4	23CE076	Port and Harbour Engineering	DEC	3	0	0	3	3
5	23CE077	Coastal Hazards and Mitigation	DEC	3	0	0	3	3
6	23CE078	Offshore Structures	DEC	3	0	0	3	3

OPEN ELECTIVE – EMERGING TECHNOLOGIES

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23OAD971	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	2	3	3
2	23OCS971	Augmented Reality and Virtual Reality	OEC	3	0	2	3	3
3	23OEC971	IoT Concepts and Applications	OEC	3	0	2	3	3
4	23OED972	Intellectual Property Law	OEC	3	0	0	3	3
5	23OED973	Circular Economy	OEC	3	0	0	3	3
6	23OEE971	Renewable Energy Technologies	OEC	3	0	0	3	3
7	23OME972	Introduction to Non-Destructive Testing	OEC	3	0	0	3	3
8	23OPH972	Nanotechnology	OEC	3	0	0	3	3

OPEN ELECTIVE – MANAGEMENT COURSES

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23OMG971	Total Quality Management	OEC	3	0	0	3	3
2	23OMG972	Engineering Economics and Financial Accounting	OEC	3	0	0	3	3
3	23OMG973	Engineering Management and Law	OEC	3	0	0	3	3
4	23OMG974	Knowledge Management	OEC	3	0	0	3	3
5	23OMG975	Industrial Management	OEC	3	0	0	3	3

6	23OMG976	Entrepreneurship and Business opportunities	OEC	3	0	0	3	3
7	23OMG977	Modern Business Administration and Financing	OEC	3	0	0	3	3
8	23OMG978	Essentials of Management	OEC	3	0	0	3	3

OPEN ELECTIVE – SAFETY RELATED COURSES

Sl. No.	Course code	Course Title	Cate Gory	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23OAU981	Automotive Safety	OEC	3	0	0	3	3
2	23OCE981	Disaster Management	OEC	3	0	0	3	3
3	23OME981	Industrial Safety	OEC	3	0	0	3	3

SEMESTER-WISE CREDIT DISTRIBUTION

SEMESTER	HSMC	BSC	ESC	PCC	DEC	OEC	EEC	Total
Semester I	5	11	5					**21**
Semester II	4	7	9	5				**25**
Semester III	3	4		17				**24**
Semester IV		4		16	3		1	**24**
Semester V			2	13	3	3	2	**23**
Semester VI			5	6	6	3	3	**23**
Semester VII			2	4	6	3	5	**20**
Semester VIII							10	**10**
Total	**12**	**26**	**23**	**61**	**18**	**9**	**21**	**170**

SEMESTER –I

23IP101	INDUCTION PROGRAMME	L	T	P	C
		-	-	-	0

COURSE OBJECTIVES:

- This is a mandatory 2 weeks Programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.
- The induction Programme has been introduced by AICTE with the following objectives.
- Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.
- One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.
- Hence, the purpose of this Programme is to make the

students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature. • **Physical Activity** This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc., • **Life skills** Every student would choose one skill related to daily needs such as stitching, accounting, finance management, etc.,
Universal human values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through dos and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing.
Club Activity
Students will be introduced to more than 20 Clubs available in the college-both technical and non-technical. The student can choose as to which club the student will enroll in.

Value Based Communication
This module will focus on improving the communication skills of students.
Lectures by Alumni
Lectures by alumni are arranged to bring in a sense of belonging to the student towards the institution and also to inspire them to perform better.
Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.
Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.
Address by different heads
Heads of Placement, Training, Student affairs, counsellor, etc would be interacting with the students to introduce them to various measures taken in the institution for the betterment of students.
Induction Programme is totally an activity-based Programme and therefore there shall be no tests / assessments during this Programme.
REFERENCES:
Guide to Induction program from AICTE

23HS101	ESSENTIAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from short and simple correspondence.
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities.
- To help learners write coherent, short paragraphs and essays.
- To enable learners to use language efficiently while expressing their opinions via various media.

UNIT I	FORMATION OF SENTENCES	9

Reading- Read pictures-notices- short comprehension passages and recognize main ideas and specific details. Writing- framing simple and compound sentences, completing sentences, developing hints, writing text messages. Language development- Parts of Speech, Wh- Questions, yes or no questions, direct and indirect questions. Vocabulary development– prefixes- suffixes- articles – countable and uncountable nouns.

UNIT II	NARRATION AND DESCRIPTION	9

Reading – Read short narratives and descriptions from newspapers, dialogues and conversations. Reading strategies and practices. Language development – Tenses- simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future, future continuous, past participle, pronouns. Vocabulary development- guessing meanings of words in context. Writing – Write short narrative paragraphs, biographies of friends/relatives - writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures.

UNIT III	COMPARING AND CONTRASTING	9
Reading- short texts and long texts -understanding different types of text structures, -coherence-jumbled sentences. Language development- degrees of comparison, concord- Vocabulary development – single word substitutes- discourse markers- use of reference words Writing - comparative and contrast paragraphs writing- topic sentence- main idea, free writing, compare and contrast using some suggested vocabulary and structures.		
UNIT IV	**SOCIAL MEDIA COMMUNICATION**	**9**
Reading- Reading blogs, social media reviews, posts, comments, process description, Language development - relative clause, Vocabulary development- social media terms-words, abbreviations and acronyms Writing- -e-mail writing-conventions of personal email, descriptions for simple processes, critical online reviews, blog, website posts, commenting to posts.		
UNIT V	**ESSAY WRITING**	**9**
Reading- Close reading non-technical longer texts Language development - modal verbs, phrasal verbs- Vocabulary development - collocation. Writing- Writing short essays-brainstorming – developing an outline- identifying main and subordinate ideas.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize simple, level-appropriate texts of around 300 words recognizing main ideas and specific details.
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.

CO3:	Use appropriate expressions to describe, compare and contrast people, things, situations etc., in writing.
CO4:	Establish the ability to communicate effectively through emails.
CO5:	Determine the language use appropriate for different social media platforms.
CO6:	Use appropriate expressions for narrative descriptions and process descriptions.
TEXT BOOKS:	
1	Susan Proctor, Jack C. Richards, Jonathan Hull., "Interchange Level 2", Cambridge University Press and Assessment.
2	Susan Proctor, Jack C. Richards, Jonathan Hull, "Interchange Level 3", Cambridge University Press and Assessment.
REFERENCES:	
1	Dutt P. Kiranmai and Rajeevan Geeta, "Basic Communication Skills", Foundation Books: 2013.
2	Means,L. Thomas and Elaine Langlois, "English & Communication for Colleges", Cengage Learning , USA: 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td rowspan="2">23MA101</td><td rowspan="2">MATRICES AND CALCULUS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">
To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
To familiarize the students with differential calculus.
To familiarize the student with functions of several variables. This is needed in many branches of engineering.
To make the students understand various techniques of integration.
To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
</td></tr>
<tr><td>UNIT I</td><td colspan="4">MATRICES</td><td>9</td></tr>
<tr><td colspan="6">Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.</td></tr>
<tr><td>UNIT II</td><td colspan="4">DIFFERENTIAL CALCULUS</td><td>9</td></tr>
<tr><td colspan="6">Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.</td></tr>
<tr><td>UNIT III</td><td colspan="4">FUNCTIONS OF SEVERAL VARIABLES</td><td>9</td></tr>
<tr><td colspan="6">Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multiplier.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">INTEGRAL CALCULUS</td><td>9</td></tr>
<tr><td colspan="6">Definite and Indefinite integrals - Substitution rule - Techniques of</td></tr>
</table>

Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		
UNIT V	**MULTIPLE INTEGRALS**	**9**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
	After completion of the course, the students will be able to:	
CO1:	Apply the matrix algebra techniques and applications in Engineering Problems.	
CO2:	Make use of the concept of limits and rules of differentiation to differentiate functions.	
CO3:	Find the derivative of functions of several variables.	
CO4:	Examine the application of partial derivatives.	
CO5:	Compute integrals by different techniques of Integration.	
CO6:	Apply the concept of integration to compute multiple integrals.	
TEXT BOOKS:		
1	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.	
2	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.	
REFERENCES:		
1	Dr.P.Sivaramakrishnadas, Dr.C.Vijayakumari., ― Matrices and Calculus‖ Pearson Publications Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.	
2	Anton. H, Bivens, I and Davis. S, "Calculus", Wiley, 10th Edition, 2016.	

3	Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4	Narayanan. S. and Manicavachagom Pillai.T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td rowspan="2">23AD101</td><td rowspan="2" colspan="2">PROGRAMMING IN PYTHON</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">

To know the basics of Programming.
To convert an algorithm into a Python program.
To construct Python programs with control structures.
To structure a Python Program as a set of functions.
To use Python data structures-lists, tuples, dictionaries and files.

</td></tr>
<tr><td>UNIT I</td><td colspan="5">COMPUTATIONAL THINKING</td><td>9</td></tr>
<tr><td colspan="7">Introduction to Computing and Problem Solving: Fundamentals of Computing –Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).</td></tr>
<tr><td>UNIT II</td><td colspan="5">INTRODUCTION TO PYTHON</td><td>9</td></tr>
<tr><td colspan="7">Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, type () Function and Is Operator, Dynamic and Strongly Typed Language. Control Flow Statements: if, if…else, if…elif…else Decision Control Statements, Nested if Statement, while Loop, for Loop, continue and break Statements.</td></tr>
<tr><td>UNIT III</td><td colspan="5">FUNCTIONS AND STRINGS</td><td>9</td></tr>
<tr><td colspan="7">Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number,</td></tr>
</table>

String Slicing and Joining, String Methods, Formatting Strings.		
UNIT IV	**LISTS, TUPLES, DICTIONARIES AND FILES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list Parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension. Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.		
UNIT V	**OBJECT- ORIENTED AND FUNCTIONAL PROGRAMMING**	**9**
Object-Oriented Programming: Classes and Objects, Creating Classes in Python,Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, Polymorphism. Functional Programming: Lambda. Iterators, Generators, List Comprehensions.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs using Control Statements.
CO3:	Develop simple Python programs for solving problems using Functions and Strings.
CO4:	Build a Python program using lists, tuples, dictionaries and files.
CO5:	Construct a code related to Object-Oriented.
CO6:	Construct a code related to Functional Programming.
TEXT BOOKS:	
1	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3,

	Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/).
2	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
REFERENCES:	
1	Richard L. Halterman, "Learning To Program with Python", Copyright © 2011.
2	Dr. Charles R. Severance, "Python for Everybody, Exploring Data Using Python", 2016.
3	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
4	G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
5	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press , 2021.
6	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
7	https://www.python.org/
8	Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
6	3	2	1	1	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS102	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- Explain the classical literature of Tamil and highlight notable Tamil poets.
- Explain the creation of traditional Tamil musical instruments.
- Explain the sports and games associated with Tamil heritage.
- Explore the education and literacy practices during the Sangam period.
- Explain the contributions of Tamils to the Indian freedom struggle.
- Explain the development and history of printing in Tamil Nadu.

UNIT I	LANGUAGE AND LITERATURE	3

Language Families in India – Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature – Management Principles in Thirukural – Tamil Epics and Impact of Buddhism & Jainism in Tamil Land – Bakthi Literature Azhwars and Nayanmars – Forms of minor Poetry – Development of Modern literature in Tamil – Contribution of Bharathiyar and Bharathidhasan.

UNIT II	HERITAGE – ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3

Hero stone to modern sculpture – Bronze icons – Tribes and their handicrafts – Art of temple car making – – Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments – Mridhangam, Parai, Veenai, Yazh and Nadhaswaram – Role of Temples in Social and Economic Life of Tamils.

UNIT III	**FOLK AND MARTIAL ARTS**	**3**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.		
UNIT IV	**THINAI CONCEPT OF TAMILS**	**3**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas.		
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
		TOTAL: 15 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the evolution of Tamil language and literature, focusing on its cultural, ethical, and secular themes.
CO2:	Outline the making of musical instruments related to Tamil heritage.
CO3:	Discuss the sports and games of Tamils.
CO4:	Explain the education and literacy during Sangam age.
CO5:	Express the importance and contribution of Tamils to Indian Freedom Struggle.
CO6:	Outline the print history of books in Tamil Nadu.

TEXT BOOKS:

1. தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).

REFERENCES:

1. **கீழடி- வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)**
2. பொருனை- ஆற்றங்கரை **நாகரிகம் (தொல்லியல் துறை வெளியீடு)**

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
6	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Overall Correlation		-	-	-	-	2	2	-	-	-	-	-	-	-	-

Recommended by Board of Studies	02-08-2023		
Approved	1st ACM	Date	09-09-2023

23PH111	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of optics and lasers.
- To equip the students successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I	MECHANICS	9

Types of stress, Stress-strain diagram and its uses- factors affecting elastic modulus- tensile strength- Bending of beams, bending moment – theory and experiment: Uniform and non-uniform bending, Center of mass (CM) – CM of continuous bodies –rod, motion of the CM. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of rod, disc, solid sphere – M.I of a diatomic molecule - torque -rotational energy state of a rigid diatomic molecule – M.I of disc by torsional pendulum

UNIT II	ELECTROMAGNETIC WAVES	9

Concept of field-introduction to gradient, divergence and curl of field – Stokes theorem (No proof)-Gauss divergence theorem (No proof) - The Maxwell's equations in integral form and differential form - wave equation; Plane electromagnetic waves in vacuum - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Energy and momentum in EM waves-Poynting's vector - Cell-phone reception.

UNIT III	OPTICS AND LASERS	9

Reflection and refraction of light waves - total internal reflection –

types of optical fiber, Numerical Aperture and acceptance angle - interference –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients(Qualitative) - population inversion - CO_2 laser, semiconductor laser (Homo junction) - Applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**ADVANCED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		TOTAL: 45 PERIODS
PRACTICAL EXERCISES: (Any Seven Experiments)		
1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects 2. Simple harmonic oscillations of cantilever 3. Non-uniform bending- Determination of Young's modulus 4. Uniform bending–Determination of Young's modulus 5. Laser-Determination of the wavelength of the laser using grating 6. Airwedge- Determination of thickness of a thinsheet /wire		

	7. a) Optical fibre-Determination of Numerical Aperture and acceptance angle b) Compact disc-Determination of width of the groove using laser. 8. Acoustic grating-Determination of velocity of ultrasonic waves in liquids. 9. Ultrasonic interferometer–determination of the velocity of sound and compressibility of liquids 10. Post office box-Determination of Band gap of a semiconductor. 11. Photoelectric effect 12. Michelson Interferometer. 13. Melde's string experiment 14. Experiment with lattice dynamics kit.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Determine the mechanical properties of materials.
CO2:	Apply the principles of electromagnetic waves to real world system.
CO3:	Determine the thickness of thin wire and the characteristic parameter of an optical fiber.
CO4:	Apply the principles of lasers to real world application.
CO5:	Organize the quantum mechanical properties of particles and waves.
CO6:	Utilize the quantum mechanical principles towards the formation of energy bands.
TEXT BOOKS:	
1	D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education (Indian Edition), 2017.
2	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCES:

1	R.Wolfson," Essential University Physics", Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2	Paul A. Tipler, "Physic – Volume 1 & 2", CBS, (Indian Edition), 2004.
3	K.Thyagarajan and A.Ghatak,"Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2019.
4	D.Halliday, R.Resnick and J.Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5	N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students",Springer Verlag, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**26-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CY111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	1	4

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage batteries.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Sewage treatment primary treatment and disinfection (UV, Ozonation, break-point chlorination). Hardness-Estimation of Hardness of water by EDTA-numerical Problems-Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials (Metal oxide and Metal) Synthesis and Characterization of nanomaterials: sol-gel, solvothermal, laser ablation, chemical

vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, energy, sensor , electronics and catalysis.		
UNIT III	**PHASE RULE AND COMPOSITES**	**9**
Phase rule: Introduction, definition of terms with examples. One component system – water system; CO_2 system; Reduced phase rule; Two component system: lead-silver system – Pattinson process. Composites: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites – definition and examples.		
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Fossil Fuels, Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil – cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method. CO_2 emission and carbon sequestration, Green Hydrogen.		
UNIT V	**ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear fission and fusion- light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery – dry cell, Secondary battery – lead acid battery and lithium-ion battery; Electric vehicles – working		

principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell and its advanced technology, supercapacitor.	
TOTAL: 45 PERIODS	
LIST OF EXPERIMENTS **TOTAL: 30 PERIODS**	
1. Determination of hardness causing salts in water sample by EDTA method. 2. Determination of alkalinity in water sample. 3. Determination of chloride content of water sample by argentometric method. 4. Determination of strength of given Barium chloride using conductivity meter. 5. Determination of strength of Acid using pH meter. 6. Determination of strength of FAS by potentiometer 7. Determination of strength of acids in a mixture using conductivity meter. 8. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method. **9.** Estimation of Nickel in steel	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	Illustrate the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	Estimate the knowledge of phase rule and composites for material selection requirements
CO4:	Choose a suitable fuel for engineering processes and applications
CO5:	Relate the different forms of energy resources and apply them for suitable applications in energy sectors.
CO6:	Explain the different types of batteries, fuel cells and working principles of Electric vehicles

TEXT BOOKS:	
1	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3	S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
REFERENCES:	
1	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014New Delhi, 2018.
4	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019
5	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
2	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
4	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
5	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
6	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Recommended by Board of Studies	28-07-2023		
Approved	1st ACM	Date	09-09-2023

23AD121	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objective of this laboratory is to put into practice computational thinking. The students will be expected to write, compile, run and debug Python programs to demonstrate the usage of:

- Operators and Conditional Statements.
- Control Structures and Functions (both recursive and iterative) and Recursion.
- String functions.
- Lists, Sets, Dictionaries, Tuples and Files.
- Object-Oriented Programming.

Exercise 1	**Programs to demonstrate the usage of operators and conditional statements.**

1. Write a program that takes two integers as command line arguments and prints the sum of two integers.
2. Program to display the information:
   Your name, Full Address, Mobile Number, College Name, Course Subjects.
3. Program that reads the URL of a website as input and displays contents of a webpage.

Exercise 2	**Programs to demonstrate usage of control structures.**

4. Program to find the sum of all prime numbers between 1 and 1000.
5. Program to find the product of two matrices.
6. Program to find the roots of a quadratic equation.

Exercise 3	**Programs to demonstrate the usage of Functions and Recursion**

7. Write both recursive and non-recursive functions for the following:
   a. To find GCD of two integers.
   b. To find the factorial of positive integer.
   c. To print Fibonacci Sequence up to given number ‗n'

	d. To convert decimal number to Binary equivalent. 8. Program with a function that accepts two arguments: a list and a number ‗n'. It should display all the numbers in the list that are greater than the given number ‗n'. 9. Program with a function to find how many numbers are divisible by 2, 3,4,5,6 and 7 between 1 to 1000.
Exercise 4	**Programs to demonstrate the usage of String functions.**
	10. Program that accepts two strings S1, S2, and finds whether they are equal are not. 11. Program to count the number of occurrences of characters in each string. 12. Program to find whether a given string is palindrome or not.
Exercise 5	**Programs to demonstrate the usage of lists, sets, dictionaries, tuples and files.**
	13. Simple sorting, Histogram, Students marks statement, Retail bill preparation 14. Write a program that combines lists L1 and L2 into a dictionary. 15. Program to display a list of all unique words in a text file and word count, copy file, Voter's age validation, Marks range validation (0-100).
Exercise 6	**Programs to demonstrate the usage of Object-Oriented Programming**
	16. Program to implement the inheritance. 17. Program to implement polymorphism.
	TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs.

CO3:	Construct programs in Python using conditionals and loops for solving problems.
CO4:	Utilize functions to decompose a Python program.
CO5:	Analyse compound data using Python data structures.
CO6:	Interpret data from/to files in Python Programs.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	-	-	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
5	3	3	2	2	1	-	-	-	-	-	-	1	3	1	-
6	2	1	-	-	1	-	-	1	1	1	1	1	3	1	1
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**1**

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td>23HS121</td><td colspan="2">COMMUNICATION SKILLS LABORATORY</td><td>L
0</td><td>T
0</td><td>P
2</td><td>C
1</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To enable the students to comprehend the main idea and specific information of the listening passage
• To help students express themselves clearly, and communicate effectively with others
• To introduce authentic language use and context-specific vocabulary that might not be encountered in textbooks</td></tr>
<tr><td>Exercise : 1</td><td colspan="6">Listening to conversations set in everyday social context and complete gap-filling exercise</td></tr>
<tr><td>Exercise : 2</td><td colspan="6">Listening to a monologue in everyday social context. Diagram labelling and MCQ</td></tr>
<tr><td>Exercise : 3</td><td colspan="6">Listening to a group conversation in academic setting and answer MCQ</td></tr>
<tr><td>Exercise : 4</td><td colspan="6">Listening to a lecture and answer MCQ or gap filling</td></tr>
<tr><td>Exercise : 5</td><td colspan="6">Listening to Ted Talks, podcasts, documentaries - discussion</td></tr>
<tr><td>Exercise : 6</td><td colspan="6">Listening to a lecture and reading a text on the same subject- compare and contrast</td></tr>
<tr><td>Exercise : 7</td><td colspan="6">Speaking Introducing oneself</td></tr>
<tr><td>Exercise : 8</td><td colspan="6">Answering questions based on the introduction</td></tr>
<tr><td>Exercise : 9</td><td colspan="6">Speaking on a given prompt for 2 mins.</td></tr>
<tr><td>Exercise : 10</td><td colspan="6">Answering questions based on the topic spoken</td></tr>
<tr><td>Exercise : 11</td><td colspan="6">Role play- Engaging in conversation</td></tr>
<tr><td>Exercise : 12</td><td colspan="6">Engaging in Podcast Discussion</td></tr>
<tr><td colspan="7" align="right">TOTAL: 25 PERIODS</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="6">Demonstrate fluency in speaking in variety of situations</td></tr>
<tr><td>CO2:</td><td colspan="6">Express their knowledge by talking continuously for more than two minutes on a topic</td></tr>
</table>

CO3:	Develop active listening for more meaningful interactions and conversations
CO4:	Use a full range of structures naturally and appropriately
CO5:	Identify the specific information in conversations, interviews, talks and lectures
CO6:	Develop the ability to compare and analyse different forms of information, identifying key similarities and differences.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	2	3	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
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SEMESTER - II

23HS201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from longer, technical and scientific texts.
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities.
- To help learners write coherent, extensive reports and essays.
- To enable learners to use language efficiently while expressing their opinions in professional and business situations.

UNIT I	WORKPLACE COMMUNICATION	9

Reading – Reading brochures (technical context), advertisements, telephone messages, gadget reviews social media messages, digital communication relevant to technical contexts and business. Writing – Writing emails -emails on professional contexts including introducing oneself, writing checklist, writing single sentence definition, product description- advertising or marketing slogans, Language Development– Tenses, Concord, Question types: Why/ Yes or No/ and Tags, imperative sentences, complex sentences. Vocabulary - One-word substitutes; Abbreviations & Acronyms as used in technical contexts and social media.

UNIT II	EXPRESSING CAUSE AND EFFECT	9

Reading - Reading longer technical texts– Cause and Effect Essays, and emails of complaint. Writing - writing complaint emails (raising tickets) and responses to complaints, writing Cause and effect paragraphs and essays. Language Development– Active, Passive and Impersonal Passive Voice transformations, Infinitive and Gerunds Vocabulary – Synonyms- contextual meaning of

words, Same word acting as different parts of speech, causal expressions.		
UNIT III	**PROVIDING SOLUTIONS TO PROBLEMS**	**9**
Reading - Case Studies, editorials, news reports etc. Writing – Letter to the Editor, Writing instructions and recommendations, Problem solution essay / Argumentative Essay, Language Development – Error correction; If conditional sentences Vocabulary - Compound Words, discourse markers.		
UNIT IV	**INTERPRETATION OF GRAPHICS**	**9**
Reading - Reading newspaper articles, nonverbal communication (charts and graphs) Writing –Transferring information from nonverbal (chart, graph etc, to verbal mode) Process– description. Language development–Possessive & Relative pronouns, numerical adjectives Vocabulary Homonyms and Homophones, sequence words.		
UNIT V	**REPORT WRITING AND RESUME WRITING**	**9**
Reading – Company profiles, journal reports. Language Development– Reported Speech Vocabulary-reporting words and phrases. Writing - Writing accident report, survey report and progress report, project proposal, minutes of the meeting, writing statement of purpose, internship application and resume.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize long technical and scientific text of not less than 500 words recognizing main ideas and specific details.
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.
CO3:	Use appropriate expressions to describe process and product, compare and contrast data, analyze problems, provide solutions and prove an argument in writing.

CO4:	Establish the ability to communicate effectively in professional environment through emails and reports.
CO5:	Determine the language use appropriate for different social media platforms used for digital marketing.
CO6:	Convert skills to assets and position themselves in job market through their own professional narratives.
TEXT BOOKS:	
1	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, "English for Science & Technology I", Cambridge University Press and Assessment.
2	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, "English for Science & Technology II", Cambridge University Press and Assessment.
REFERENCES:	
1	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
2	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
5	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
Overall Correlation	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td rowspan="2">23MA203</td><td rowspan="2">STATISTICS AND NUMERICAL METHODS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
</table>

COURSE OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I	**TESTING OF HYPOTHESIS**	**9+3**

Sampling distributions – Standard error-Large sample test for single mean, proportion, difference of means -Small sample Tests– T Test for single mean and difference of means-F test for equality of variance – Chi square test for single variance- Independence of attribute-Goodness of fit (Binomial Distribution, Poisson Distribution).

UNIT II	**DESIGN OF EXPERIMENTS**	**9+3**

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT III	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**9+3**

Solution of algebraic and transcendental equations - Fixed

<table>
<tr><td colspan="3">point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a square matrix by Power method.</td></tr>
<tr><td>UNIT IV</td><td>INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION</td><td>9+3</td></tr>
<tr><td colspan="3">Interpolation - Newton’s forward and backward difference interpolation -Lagrange’s and Newton’s divided difference interpolations –– Approximation of derivative using interpolation polynomials – Numerical single integration and double using Trapezoidal and Simpson’s 1/3 rules.</td></tr>
<tr><td>UNIT V</td><td>NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS</td><td>9+3</td></tr>
<tr><td colspan="3">Single step methods: Taylor’s series method - Euler’s method - Modified Euler’s method - Fourth order Runge- Kutta method for solving first order differential equations - Multi step methods: Milne’s and Adam’s Bashforth method.</td></tr>
<tr><td colspan="3" align="right">TOTAL: 60 PERIODS</td></tr>
<tr><td colspan="3">COURSE OUTCOMES:</td></tr>
<tr><td colspan="3">After completion of the course, the students will be able to:</td></tr>
<tr><td>CO1:</td><td colspan="2">Examine the given data for large and small samples problems.</td></tr>
<tr><td>CO2:</td><td colspan="2">Examine the problems involving design of experiments.</td></tr>
<tr><td>CO3:</td><td colspan="2">Find the numerical solutions for nonlinear (algebraic or transcendental) equations, large system of linear equations and Eigen value problem of a matrix, when analytical methods fail to give solution.</td></tr>
<tr><td>CO4:</td><td colspan="2">Determine the intermediate values of the experimental data, using Newton’s forward, backward, divided difference and Lagrange’s methods.</td></tr>
</table>

CO5:	Find the solutions for the problems involving numerical differentiation and integration.
CO6:	Solve numerically, ordinary differential equations which is used to solve different kinds of problems occurring in engineering and technology.
TEXT BOOKS:	
1	P. Sivarama Krishna Das "A Text Book of Statistics and Numerical Methods" Viji's Academy.
2	T.Veerarajan "Probability, Statistics, Random Processes" Tata Mcgraw Hill Publications.
REFERENCES:	
1	Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23PH201	PHYSICS FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of heat transfer through different materials, thermal performance of building and various thermal applications.
- To impart knowledge on the ventilation and air conditioning of buildings.
- To introduce the concepts of sound insulation and lighting designs.
- To give an introduction to the processing and applications of new engineering materials.
- To create an awareness on natural disasters and safety measures.

UNIT I	THERMAL APPLICATIONS	9

Principles of heat transfer, steady state of heat flow, conduction through compound media - Series and parallel - Conductivity of rubber tube and powder materials - Heat transfer through fenestrations, thermal insulation and its benefits - Heat gain and heat loss estimation - Factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices - Central heating.

UNIT II	VENTILATION AND REFRIGERATION	9

Requirements, principles of natural ventilation - Ventilation measurements, design for natural ventilation - Window types and packaged air conditioners - Chilled water plant - fan coil systems - Water piping - Cooling load - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C.Systems.

UNIT III	ACOUSTICS AND LIGHTING DESIGNS	9

Methods of sound absorptions - Absorbing materials – Noise and its measurements, sound insulation and its measurements, impact of noise in multistoried buildings. Visual field glare, colour - Day

light calculations - Say light design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting, supplementary artificial lighting.		
UNIT IV	**NEW ENGINEERING MATERIALS**	**9**
Composites - Definition and Classification - Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) - Metallic glasses - Shape memory alloys - Ceramics - Classification - Crystalline - Non-Crystalline - Bonded ceramics, Manufacturing methods - Slip casting - Isostatic pressing - Gas pressure bonding - Properties - thermal, mechanical, electrical and chemical ceramic fibres - ferroelectric and ferromagnetic ceramics - High Aluminium ceramics.		
UNIT V	**NATURAL DISASTERS**	**9**
Seismology and Seismic waves - Earth quake ground motion - Basic concepts and estimation techniques - site effects - Probabilistic and deterministic Seismic hazard analysis - Cyclone and flood hazards - Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment - Prevention and safety measures.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Determine the heat transfer in different media and thermal performance of building, thermal insulation.
CO2:	Outline the knowledge on the ventilation and air conditioning of buildings.
CO3:	Relate the concepts of sound absorption, noise insulation.
CO4:	Discuss the lighting designs.
CO5:	Express the processing and applications of composites, metallic glasses, shape memory alloys and ceramics.
CO6:	Illustrate an awareness on natural disasters such as earth quake, cyclone, fire and safety measures.

TEXT BOOKS:	
1	Marko Pinteric, “Building Physics”, Springer 2017.
2	D.S.Mathur, “Elements of Properties of Matter”, S Chand & Company, 2010.
3	Hugo Hens, “Building Physics: Heat, Air and Moisture”, Wiley, 2017.
REFERENCES:	
1	W.R.Stevens, “Building Physics: Lighting. Pergamon Press”, 2013.
2	Jasprit Singh, “Semiconductor Optoelectronics: Physics and Technology”, McGraw-Hill Education (Indian Edition), 2019.
3	Hugo Hens, “Applied Building Physics”, Wiley, 2016 4. Mark Fox, Optical Properties of Solids, Oxford Univ. Press, 2001.
4	K.G.Budinski and M.K.Budinski, “Engineering Materials: Properties and Selection”, Pearson Education, 2016.
5	Peter A. Claisse, “Civil Engineering Materials”, Elsevier, 2016.
6	Patrick L. Abbott, “Natural Disasters”, McGraw-Hill, 2017.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
4	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
5	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
6	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CE201	BUILDING MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
The learning objective of this course is to introduce various materials commonly used in civil engineering construction and their properties.

UNIT I	STONES - AGGREGATES	9
Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work - Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.		
UNIT II	**BRICKS – CONCRETE BLOCKS**	**9**
Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Lightweight concrete blocks.		
UNIT III	**LIME – CEMENT– MORTAR**	**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 – Industrial byproducts – Fly ash.		
UNIT IV	**TIMBER – METALS - OTHER MATERIALS**	**9**
Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.		
UNIT V	**MODERN MATERIALS**	**9**
Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials –		

Types – Applications of laminar composites – Fibre textiles – Geomembranes and Geotextiles for earth reinforcement.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Compare the properties of most common building material stones and aggregates.
CO2:	Explain the properties and test on bricks and concrete blocks.
CO3:	Explain the manufacturing process, types and properties of lime and cement.
CO4:	Demonstrate the quality assurance test on cement.
CO5:	Interpret the applications of timbers, metals and other materials.
CO6:	Summarize the importance of modern material for construction.
TEXT BOOKS:	
1	Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2	Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3	Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004.
4	Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.
REFERENCES:	
1	Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2	Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3	IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011.
4	IS4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012.

5	IS383 - 1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011.
6	IS1542-1992: Indian standard specification for sand for plaster, 2009.
7	IS 10262-2009: Indian Standard Concrete Mix Proportioning –Guidelines, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	1	-	-	-	2	2	-	1
2	2	1	-	-	-	-	2	1	-	-	-	2	2	-	1
3	2	1	-	-	-	-	3	1	-	-	2	-	2	-	1
4	2	1	-	-	-	-	-	1	-	-	2	-	2	-	1
5	2	1	-	-	2	2	-	1	2	-	3	2	2	2	1
6	2	1	-	-	2	2	-	1	2	-	3	2	2	2	1
Overall Correlation	2	1	-	-	1	1	2	1	1	-	2	2	2	1	1

Recommended by Board of Studies	**02-08-2023**		
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23HS203	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To summarize the weaving industry and ceramic technology during Sangam Age.
- To explain the design and construction of houses during Sangam Age and the sculptures and temples of Chola,Pallava and Pandya period.
- To Explain about the water bodies of Sangam age and relate it to the agricultural usage.
- To outline to students the agriculture and irrigation technology during the Chola Period.
- To help students Interpret and explain the digitalization of Tamil books and development of Tamil software.

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
		TOTAL: 15 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the weaving industry and ceramic technology during Sangam Age.
CO2:	Explain the design and construction of houses during Sangam Age.
CO3:	Explain the sculptures and temples of Chola,Pallava and Pandya period.
CO4:	Explain about the water bodies of Sangam age and relate it to the agricultural usage.
CO5:	Outline the agriculture and irrigation technology during the Chola Period.
CO6:	Interpret and explain the digitalization of tamil books and development of Tamil software.
TEXT BOOKS:	
1	Dr.K.K.Pillay ,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL.

REFERENCES:	
1	Dr.S.Singaravelu ,"Social Life of the Tamils - The Classical Period", Published by: International Institute of Tamil Studies.
2	Dr.S.V.Subramanian and Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", Published by: International Institute of Tamil Studies.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
2	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
6	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	**1**	-	-	-	-	-	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

<table>
<tr><td>23EE282</td><td colspan="2">BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING</td><td>L
2</td><td>T
0</td><td>P
2</td><td>C
3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">

To introduce the basics of electric circuits and analysis
To impart knowledge in domestic wiring
To impart knowledge in the basics of working principles and application of electrical machines
To introduce analog devices and their characteristics
To introduce the functional elements and working of sensors and transducers

</td></tr>
<tr><td>UNIT I</td><td colspan="5">ELECTRICAL CIRCUITS</td><td>6</td></tr>
<tr><td colspan="7">DCCircuits:CircuitComponents:Conductor,Resistor,Inductor,Capacitor–Ohm’sLaw-Kirchhoff’sLaws -Nodal Analysis, Mesh analysis within dependent sources only (Steady state)-Introduction to AC Circuits–Steady state analysis of RL, RC, and RLC Circuits(Simple problems only)</td></tr>
<tr><td>UNIT II</td><td colspan="5">ELECTRICAL INSTALLATIONS</td><td>6</td></tr>
<tr><td colspan="7">Domestic wiring, types of wires and cables, earthing, protective devices- switch fuse unit-Miniature circuit breaker-moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid</td></tr>
<tr><td>UNIT III</td><td colspan="5">ELECTRICAL MACHINES</td><td>6</td></tr>
<tr><td colspan="7">Construction and Working principle of DC Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. -Construction, Working principle and Applications of Single- Phase Transformer</td></tr>
<tr><td>UNIT IV</td><td colspan="5">ANALOG ELECTRONICS</td><td>6</td></tr>
<tr><td colspan="7">PN Junction Diodes, Zener Diode –characteristics Applications –Bipolar Junction Transistor- JFET,SCR - I-V Characteristics and Applications- Rectifier</td></tr>
</table>

UNIT V	SENSORSANDTRANSDUCERS	6
Sensors, proximity sensors, piezo-electric hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, Introduction to Smart sensors.		
		TOTAL : 30 PERIODS

LAB COMPONENT

1. Verification of ohms and Kirchhoffs Laws.
2. Load test on DC Shunt Motor.
3. Load test on Single phase Transformer
4. Characteristics of PN and Zener Diodes
5. Design and analysis of Half wave and Full Wave rectifiers
6. Measurement of displacement of LVDT

TOTAL : 30 + 30 = 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply fundamental laws to DC electric circuits and demonstrate it experimentally.
CO2:	Explain the steady state AC circuits with RL, RC, and RLC circuits.
CO3:	Summarize the concept of domestic wiring and protective devices.
CO4:	Identify the working principle and applications of electrical machines with experimental results.
CO5:	Demonstrate the characteristics of various analog electronic devices
CO6:	Infer the types and operating principles various sensors and transducers and demonstrate the use of LVDT to measure displacement.

TEXT BOOKS:

1	D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020

2	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements &Instrumentation', Dhanpat Rai and Co, 2015.
3	S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4	James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley,2018
REFERENCES:	
1	John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
2	Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition,2017
4	Muhammad H. Rashid, "Spice for Circuits and electronics", 4th Edition., Cengage India,2019.
5	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
2	2	1	-	-	-	-	-	1	1	1	-	1	2	-	1
3	2	1	-	-	-	1	1	1	1	1	-	1	2	-	1
4	3	2	1	1	-	1	1	1	1	1	-	1	3	-	1
5	2	1	-	-	-	-	-	1	1	1	-	1	3	-	1
6	2	1	-	-	-	-	-	1	-	-	-	-	2	-	1
Overall Correlation	3	2	1	1	-	1	1	1	1	1	-	1	3	-	1

Recommended by Board of Studies	**14-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23ME211	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Gain a solid foundation in the fundamental principles and concepts of engineering graphics, including conic sections, orthographic projection, isometric projection, section views and development of surfaces, perspective projection, and dimensioning.
- Develop graphic skills for communication of concepts, ideas and design of engineering products.
- Gain knowledge on drafting software to construct part models.
- Familiarize with existing national standard practices and conventions related to technical drawings.
- Enhance the ability to visualize objects in three dimensions and translate them into 2D representations.

UNIT I	PLANE CURVES	9+6

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

LIST OF EXERCISES:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	9+6

Orthographic projection - principles - Principal planes - First angle projection - projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (hexagonal and pentagonal planes only) inclined to both the principal planes by rotating object method.

LIST OF EXERCISES:

1. Draw the projection of points when it is placed in different quadrants
2. Draw the projection of lines when it is placed in first quadrant
3. Draw the planes when it is placed in first quadrant.

UNIT III	PROJECTION OF SOLIDS AND FREE HAND SKETCHING	9+6

Projection of simple solids - hexagonal prism, pentagonal pyramid and cone inclined to the horizontal plane by rotating object method. Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views - Free hand sketching of multiple views from pictorial views of objects

LIST OF EXERCISES:

1. Practicing three dimensional modelling of simple objects.
2. Drawing of orthographic views from the given pictorial diagram

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	9+6

Sectioning of hexagonal prism, pentagonal pyramid and cone when the cutting plane is inclined to the horizontal plane, Development of lateral surfaces of simple and sectioned solids – hexagonal prism and cone cut by a plane inclined to horizontal plane only.

LIST OF EXERCISES:

1. Draw the sectioned views of prisms and pyramids
2. Draw the development of hexagonal prism cut by a section plane inclined to the horizontal plane

UNIT V	ISOMETRIC PROJECTION	9+6

Principles of isometric projection - Isometric scale – Isometric view - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.

LIST OF EXERCISES:

1. Drawing Isometric view and projection of simple solids.
2. Drawing three dimensional modeling of isometric projection of combination of solids.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1:	Construct the conic curves, involutes and cycloids.
CO2:	Develop and Sketch the orthographic projections of points, lines and plane surfaces.
CO3:	Develop and Sketch the orthographic projections of simple solids.
CO4:	Construct the projections of sectioned solids and development of the lateral surfaces of solids.
CO5:	Develop and Sketch the isometric sections of solids.
CO6:	Develop and Sketch the orthographic projection 2D and 3D objects using Auto CAD.

TEXT BOOKS:

1	Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2019.
2	Basant Agarwal and Agarwal C.M.,―Engineering Drawing‖, McGraw Hill, 2nd Edition, 2019

REFERENCES:

1	Natrajan K.V., ―A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2018.
2	Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I and II combined), Subhas Publications, Bangalore, 27th Edition, 2017.

3	Luzzader, Warren.J. and Duff, John M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	Parthasarathy N. S. and Vela Murali, ―Engineering Graphics‖, Oxford University, Press, New Delhi, 2015. 5. Shah M.B., and Rana B.C., ―Engineering Drawing‖, Pearson Education India, 2nd Edition, 2009.
5	Venugopal K. and Prabhu Raja V., ―Engineering Graphics", New Age International (P) Limited, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
2	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
3	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
4	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
5	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
6	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
Overall Correlation	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23ME221	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Familiarize students with basic engineering tools and equipment.
- Educate students on the importance of safety practices, including proper handling of equipment, adherence to safety protocols, and understanding potential hazards in the laboratory environment. Develop basic manufacturing and fabrication skills.
- Provide hands on training to the students in plumbing and woodworking.
- Provide hands on training to the students in welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
- Demonstrate the wiring and measurement methods in common household electrical applications.
- Study the basic electronic components, gates and provide hands on training in soldering.

GROUP A (CIVIL and MECHANICAL)

PART I	CIVIL ENGINEERING PRACTICES	15

PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in households.
b) Preparation of plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK

a) Sawing
b) Planning
c) Making of T-Joint, Mortise joint and Tenon joint and Dovetail joint.

WOOD WORK STUDY

a) Study of joints in door panels and wooden furniture
b) Study of common industrial trusses using models.

PART II	MECHANICAL ENGINEERING PRACTICES	15

WELDING WORK

a) Study of Welding and its tools.
b) Welding of Butt Joints, Lap Joints and Tee Joints by metal arc welding.
c) Study of Gas Welding.

BASIC MACHINING PRACTICE

a) Facing and Plain Turning
b) Taper Turning
c) Drilling and Tapping

SHEET METAL WORK

a) Forming and Bending
b) Making of a square Tray

MACHINE ASSEMBLY WORK

a) Study of Centrifugal Pump
b) Study of Air Conditioner

FOUNDRY PRACTICE

Demonstration on Foundry operations like mould preparation.

TOTAL: 30 PERIODS

GROUP B (ELECTRICAL & ELECTRONICS)

PART III	ELECTRICAL ENGINEERING PRACTICES	15

1. Residential House wiring using Switches, Fuse, Indicators, Lamp and Energy Meter.
2. Staircase Wiring.

3. Fluorescent Lamp Wiring with Introduction to CFL and LED Types. 4. Measurement of Energy using Single Phase Energy Meter. 5. Study of Iron Box Wiring and Assembly **6.** Study of Fan Regulator – Electronic Type		
PART IV	**ELECTRONICS ENGINEERING PRACTICES**	**15**
1. Study of Electronic components and equipment – Resistors, Colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering simple electronic circuits and checking continuity. 5. Study the elements of smart phone 6. Study of LED TV (Block diagram		

COURSE OUTCOMES:

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

CO1:	Plan the pipeline layout for common household plumbing work.
CO2:	Make use of welding equipment and carpentry tool for making joints.
CO3:	Demonstrate on centrifugal pump, air conditioner and foundry operations.
CO4:	Demonstrate the electrical wiring connections for household applications and study the working of iron box and fan regulator.
CO5:	Identify the basic electronic components and explain the gates and soldering methods.
CO6:	Examine the performance and operation of CRO, LED TV and Smart phone.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
2	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
3	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
4	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
5	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
6	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**2**	**2**	**2**	**2**	**1**	**-**

Recommended by Board of Studies	**26-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CE221	MATERIALS TESTING LABORATORY	L	P	C
		0	4	2
COURSE OBJECTIVES:				
• To develop skills to test various construction materials.				
LIST OF EXPERIMENTS:				

I TESTS ON FINE AGGREGATE

a. Determination of specific gravity and water absorption of fine aggregate.

b. Determination of grading of fine aggregate.

c. Determination of water absorption for fine aggregate.

II TESTS ON COARSE AGGREGATE

a. Determination of compacted and loose bulk density of coarse aggregate.

b. Determination of impact value of coarse aggregate.

c. Determination of elongation index of coarse aggregate.

d. Determination of flakiness index of coarse aggregate.

e. Determination of aggregate crushing value of coarse aggregate.

f. Determination of specific gravity and water absorption of coarse aggregate.

III TESTS ON BRICKS

a. Determination of compressive strength of bricks.

b. Determination of water absorption of bricks.

c. Determination of efflorescence of brick.

IV TEST ON WOOD

a. Determination of Compression test on wood.

V TESTS ON CEMENT

a. Determination of fineness of cement.

b. Determination of consistency of cement.

c. Determination of specific gravity of cement.

d. Determination of initial and final setting time of cement.

VI TESTS ON BITUMEN

a. Specific gravity of bitumen.

b. Penetration test on bitumen.

c. Viscosity test for bitumen.

d. Softening point test for bitumen.

	e. Estimation of loss of bitumen on heating. f. Ductility Test for bitumen. g. Marshall Stability and Flow Values.
	TOTAL: 30 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Examine the physical properties of fine aggregate.
CO2:	Examine the physical properties of coarse aggregate.
CO3:	Examine the physical properties and compressive strength of bricks.
CO4:	Examine the compressive strength of wood.
CO5:	Examine the physical properties of cement.
CO6:	Examine physical properties, stability and flow properties of bitumen.
TEXT BOOKS:	
1	Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
2	Varghese. P.C, “Building Materials”, Second Edition PHI Learning Ltd., 2015.
REFERENCES:	
1	IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011.
2	IS4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012.
3	IS383 - 1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011.
4	IS1542-1992: Indian standard specification for sand for plaster, 2009.
5	IS 10262-2009: Indian Standard Concrete Mix Proportioning –Guidelines, 2009.
6	Dr. S. K. Khanna, Dr. C. E. G. Justo and Dr. A. Veeraragavan., “Highway Materials and Pavement Testing”, Nem Chand & Bros., Roorkee, Revised Fifth Edition, 2009.

7	N.L.Arora., "A Text book of Transportation Engineering", New India Publication, 1997.
8	http://vlabs.iitb.ac.in/vlabsdev/labs/nitk_labs/Transportation_Engineering_Lab/index.html.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1
2	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1
3	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1
4	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1
5	3	3	2	2	2	2	2	1	3	1	1	2	3	2	1
6	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1
Overall Correlation	3	3	2	2	1	2	2	1	3	1	1	2	3	1	1

Recommended by Board of Studie	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS221	SOFT SKILLS	L	T	P	C
		0	0	2	1
COURSE OBJECTIVES:					
• To help learners improve their interpersonal skills and critical thinking • To familiarize learners with the attributes of a leader to enhance team performance • To prepare students to face job interviews • To help learners to know the importance of ethics in work place					
UNIT I	**INTERPERSONAL COMMUNICATION**				**6**
Basic communication- verbal and non-verbal communication; passive, assertive and aggressive communication; presentation skills; giving feedback and responding to feedback.					
UNIT II	**TEAM WORK AND LEADERSHIP**				**6**
Vision- setting realistic goals and objectives, collaboration, cooperation, dependability, empathy, sympathy, motivation, delegation of responsibilities, open mindedness, creativity, flexibility, adaptability, cross cultural communication and group dynamics.					
UNIT III	**TIME MANAGEMENT AND STRESS MANAGEMENT**				**6**
Effective Planning, Planning activities at macro and micro levels, setting practical deadlines and realistic limits/targets, punctuality, prioritizing activities, spending the right time on the right activity, positive attitude, emotional intelligence, self- awareness and regulation.					
UNIT IV	**CRITICAL THINKING AND WORK ETHICS**				**6**
Questioning, analysing, inferencing, interpreting, evaluating, solving problems, explaining, self-regulation, open-mindedness, conflict management- ethical dilemmas, appearance, attendance, attitude, character, organizational skills, productivity, respect.					

UNIT V	INTERVIEW SKILLS AND RESUME BUILDING TECHNIQUES	6
Telephonic interview, online interviews, f2f interviews, FAQ soft skills interview questions, drafting error-free CVs/ Resumes and Cover Letters, selecting the ideal format for resume, content drafting along with sequencing, art of representing one's qualifications and most relevant work history, video resume, website resume.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Express their thoughts, opinions and ideas confidently to one or more people in spoken form
CO2:	Develop evolving competences required for professional success
CO3:	Demonstrate knowledge and skills in a group as team player and leader
CO4:	Compose a comprehensive resume reflecting qualifications, exposure and achievements
CO5:	Exhibit knowledge and skills confidently during job interviews
CO6:	Demonstrate ethical and professional behaviour at workplace in all situations

TEXT BOOKS:	
1	Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman & Shalini Upadhyay. Cengage

REFERENCES:	
1	English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt, Ltd.
2	Business Benchmark by Norman Whitby. Cambridge University Press pvt, Ltd.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	-	-	-	2	2	2	3	3	2	2	-	-	2
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3
Overall Correlation	-	-	-	-	-	2	2	2	3	3	2	2	-	-	**2**
Recommended by Board of Studies								**28-07-2023**							
Approved								**1st ACM**			**Date**		**09-09-2023**		

SEMESTER –III

<table>
<tr><td rowspan="2">23MA302</td><td rowspan="2">TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

To introduce the basic concepts of PDE for solving standard partial differential equations.
To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
To acquaint the student with Fourier transform techniques used in wide variety of situations.
To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

</td></tr>
<tr><td>UNIT I</td><td colspan="4">PARTIAL DIFFERENTIAL EQUATIONS</td><td>9+3</td></tr>
<tr><td colspan="6">Formation of partial differential equations –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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">FOURIER SERIES</td><td>9+3</td></tr>
<tr><td colspan="6">Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.</td></tr>
<tr><td>UNIT III</td><td colspan="4">APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS</td><td>9+3</td></tr>
<tr><td colspan="6">Classification of second order Quasi Linear PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of Heat</td></tr>
</table>

conduction – Steady state solution of two dimensional equation of heat conduction (Infinite), (Cartesian coordinates only).		
UNIT IV	**FOURIER TRANSFORMS**	**9+3**
Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem (Without proof) – Parseval's identity.		
UNIT V	**Z-TRANSFORMS AND DIFFERENCE EQUATIONS**	**9+3**
Z-transforms - Elementary properties – Convergence of Z-transforms – Initial and final value theorems - Inverse Z-transform using partial fraction and convolution theorem - Formation of difference equations – Solution of difference equations using Z - transforms.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Solve the given standard partial differential equations.
CO2:	Compute the general Fourier series which plays a vital role in engineering applications.
CO3:	Examine the half range Fourier series and harmonic analysis
CO4:	Find the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems, one dimensional wave equations.
CO5:	Apply the mathematical principles on Fourier transforms to solve some of the physical problems of engineering.
CO6:	Apply the effective mathematical tools for the solutions of difference equations by using Z transform techniques for discrete time systems.
TEXT BOOKS:	
1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10^{th} Edition, New Delhi, 2016.

2	Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.
3	P.Sivaramakrishna Das and C.Vijayakumari “A Text Book on TPDE” Pearson Publications.

REFERENCES:

1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 44th Edition, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23CE301	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the use scalar and vector analytical techniques for analyzing forces.
- To introduce the equilibrium of rigid bodies.
- To study the properties of surfaces & solids.
- To determine the application of the concepts of frictional forces at the contact surfaces of various engineering systems.
- To develop basic dynamics concepts – force, momentum, work and energy.

UNIT I	STATICS OF PRINCIPLES	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

Principle of transmissibility - Varignon's theorem -Types of supports - Action and reaction forces - stable equilibrium - Moment of a force about a point and about an axis – Single equivalent force - Equilibrium of rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions, Analysis of Trusses – Method of Joints and Method of sections.

UNIT III	PROPERTIES OF SURFACES AND SOLIDS	9

Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Theorems of Pappus - Area moments of inertia of plane areas - rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula

- Parallel axis theorem and Perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia - mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.		
UNIT IV	**FRICTION**	**9**
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.		
UNIT V	**DYNAMICS OF PARTICLES**	**9**
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Illustrate the vectorial and scalar representation of forces and moments.
CO2:	Analyse the rigid body in equilibrium.
CO3:	Examine the properties of distributed forces in surfaces.
CO4:	Examine the properties of distributed forces in solids.
CO5:	Analyse the friction and the effects by the laws of friction.
CO6:	Analyse the dynamic forces exerted in rigid body.

TEXT BOOKS:

1	Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, "Vector Mechanics for Engineers: Statics and Dynamics", McGraw Higher Education, 11th Edition, 2017.
2	Vela Murali, "Engineering Mechanics - Statics and

	Dynamics", Oxford University Press, 2018.
REFERENCES:	
1	Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2	Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
3	Irving H. Shames, Krishna Mohana Rao G, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
4	Timoshenko S, Young D H, Rao J V and Sukumar Pati, "Engineering Mechanics", 5th Edition, McGraw Hill Higher Education, 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
2	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
3	3	3	2	2	-	-	-	-	-	-	-	2	3	-	-
4	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-
5	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-
6	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-
Overall Correlation	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23HS301	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence.
- To strengthen the self-reflection.
- To develop commitment and courage to act.

UNIT I	COURSE INTRODUCTION	9

Need, Basic Guidelines, Content and Process for Value Education - Understanding the need, basic guidelines, content and process for Value Education -Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations -Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority -Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II	UNDERSTANDING HARMONY IN THE HUMAN BEING	9

Harmony in Myself- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) -Understanding the characteristics and activities of 'I' and harmony in 'I' -Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity.

UNIT III	**UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY**	**9**
Harmony in Human-Human Relationship -Understanding Harmony in the family – the basic unit of human interaction - Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure satisfaction; Trust(Vishwas) and Respect as the foundational values of relationship -Understanding the meaning of Vishwas; Difference between intention and competence -Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship -Understanding the harmony in the society (society being an extension of family)-Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order- from family to world family.		
UNIT IV	**ENGINEERING ETHICS**	**9**
Senses of ‗Engineering Ethics„ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		
UNIT V	**SAFETY, RESPONSIBILITY AND RIGHTS**	**9**
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-Moral Leadership –Code of Conduct – Corporate Social Responsibility.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the need of value education.	
CO2:	Interpret the difference between self and body.	

CO3:	Demonstrate the need to exist as a unit of Family and society.
CO4:	Classify Harmony at all levels.
CO5:	Apply the values acquired in the professional front.
CO6:	Identify appropriate technologies for ecofriendly production systems.
TEXT BOOKS:	
1	R R Gaur, R Sangal, G P Bagaria,Human Values and Professional Ethics, Excel Books, New Delhi, 2010 3.
2	Mike W. Martin and Roland Schinzinger, ―Ethics in Engineering‖, Tata McGraw Hill, New Delhi, 2003.
3	Govindarajan M, Natarajan S, Senthil Kumar V. S, ―Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004
REFERENCES:	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book).
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology) 169 | Page .
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews.
7	Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal.
8	Rediscovering India - by Dharampal.
9	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10	India Wins Freedom - Maulana Abdul Kalam Azad.
11	Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English).
12	Charles B. Fleddermann, ―Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.

13	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases‖, Cengage Learning, 2009.
WEB SOURCES:	
1	www.onlineethics.org
2	www.nspe.org
3	www.globalethics.org

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
2	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
3	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
5	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
6	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
Overall Correlation	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**
Recommended by Board of Studies	**08-04-2024**														
Approved	**2nd ACM**			**Date**			**25-05-2024**								

<table>
<tr><td rowspan="2">23CE311</td><td rowspan="2">SURVEYING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">

- To familiarize the students with the various methods of plane and geodetic surveying to solve real-world problems.
- To familiarize the student with the concepts of Control Surveying.
- To make the students understand various techniques of modern surveying.

</td></tr>
<tr><td>UNIT I</td><td colspan="4">FUNDAMENTALS OF CONVENTIONAL SURVEYING</td><td>9</td></tr>
<tr><td colspan="6">Definition – Classifications – Basic principles – Equipment and accessories for ranging and chaining – Methods of ranging – Well-conditioned triangles – Chain traversing – Compass – Basic principles – Types – Bearing – System and conversions – Sources of errors and Local attraction – Magnetic declination – Dip – compass traversing – Plane table and its accessories – Merits and demerits – Radiation – Intersection – Resection – Plane table traversing.</td></tr>
<tr><td>UNIT II</td><td colspan="4">LEVELLING</td><td>9</td></tr>
<tr><td colspan="6">Level line – Horizontal line – Datum – Benchmarks – Levels and staves – Temporary and permanent adjustments – Methods of leveling – Fly leveling – Check leveling – Procedure in leveling – Booking – Reduction – Curvature and refraction – Reciprocal leveling – Precise leveling - Contouring.</td></tr>
<tr><td>UNIT III</td><td colspan="4">THEODOLITE SURVEYING</td><td>9</td></tr>
<tr><td colspan="6">Horizontal and vertical angle measurements – Temporary and permanent adjustments – Heights and distances – Tacheometric surveying – Stadia Tacheometry – Tangential Tacheometry – Trigonometric leveling – Single Plane method – Double Plane method.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">CONTROL SURVEYING AND ADJUSTMENT</td><td>9</td></tr>
<tr><td colspan="6">Horizontal and vertical control – Methods – Triangulation – Traversing – Gale's table – Trilateration – Concepts of measurements and errors –</td></tr>
</table>

Error propagation and Linearization – Adjustment methods - Least square methods – Angles, lengths and levelling network.		
UNIT V	**MODERN SURVEYING**	**9**
Total Station: Digital Theodolite, EDM, Electronic field book – Advantages – Parts and accessories – Working principle – Observables – Errors - COGO functions – Field procedure and applications. GPS: Advantages – System components – Signal structure – Selective availability and anti-spoofing receiver components and antenna – Planning and data acquisition – Data processing – Errors in GPS – Field procedure and applications.		
		TOTAL PERIODS : 45

LIST OF EXPERIMENTS:

CHAIN SURVEY

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset.
2. Setting out works – Foundation marking using tapes single Room and Double Room.

COMPASS SURVEY

1. Compass Traversing – Measuring Bearings & arriving included angles.

LEVELLING - STUDY OF LEVELS AND LEVELLING STAFF

1. Fly levelling using Dumpy level &Tilting level.
2. Check levelling.

THEODOLITE - STUDY OF THEODOLITE

1. Measurements of horizontal angles by reiteration and repetition and vertical angles.
2. Determination of elevation of an object using single plane method when base is Accessible/inaccessible.

TACHEOMETRY – TANGENTIAL SYSTEM – STADIA SYSTEM

1. Determination of Tacheometric Constants.
2. Heights and distances by stadia Tacheometry.
3. Heights and distances by Tangential Tacheometry.

TOTAL STATION - STUDY OF TOTAL STATION, MEASURING HORIZONTAL AND VERTICAL ANGLES 1. Traverse using Total station and Area of Traverse. 2. Determination of distance and difference in elevation between two inaccessible points using Total station. **TOTAL PERIODS: 15**	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Demonstrate the basic principles to compute distances and angles using conventional equipment.
CO2:	Compare levels and relative position of stations by various levelling instruments.
CO3:	Identify heights, distances, and horizontal and vertical angles using theodolite.
CO4:	Choose precaution, adjustment, and correction methods to erroneous survey observations.
CO5:	Develop modern surveying practices in hydrographic, geodetic and distance measure.
CO6:	Utilize the modern survey equipment using GPS.
TEXT BOOKS:	
1	Kanetkar. T.P and Kulkarni. S.V, "Surveying and Levelling, Parts 1 & 2", Pune Vidyarthi Griha Prakashan, Pune, 2008.
2	Punmia B.C, Ashok K. Jain and Arun K Jain, "Surveying Vol. I & II", Lakshmi Publications Pvt Ltd, New Delhi, 2005.
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	Satheesh Gopi, Rasathish Kumar, 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.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	1	3	2	-	2	2	2	1
2	2	1	-	-	2	2	-	1	3	2	-	2	2	2	1
3	3	2	1	1	2	2	-	1	3	2	-	2	3	2	1
4	3	2	1	1	2	2	-	1	3	2	-	2	3	2	1
5	3	2	1	1	2	2	-	1	3	2	-	2	3	2	1
6	3	2	1	1	2	2	-	1	3	2	-	2	3	2	1
Overall Correlation	3	2	1	1	2	2	-	1	3	2	-	2	3	2	1

Recommended by Board of Studies	**08-04-2024**		
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<table>
<tr><td rowspan="2">23CE312</td><td rowspan="2">ADVANCED CONCRETE TECHNOLOGY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">
• To study the properties of concrete making materials.
• To understand the application and effect of admixtures.
• To familiarize with the IS method of mix design as per the latest code and the properties of concrete.
• To familiarize with durability properties of concrete.
• To know the importance and applications of special concretes.
</td></tr>
<tr><td>UNIT I</td><td colspan="4">CONSTITUENT MATERIALS</td><td>9</td></tr>
<tr><td colspan="6">Cement-Different types-Chemical composition and Properties - Tests on cement-IS Specifications- Aggregates-Classification-Mechanical properties and tests as per BIS grading requirements-Water- Quality of water for use in concrete.</td></tr>
<tr><td>UNIT II</td><td colspan="4">ADMIXTURES</td><td>9</td></tr>
<tr><td colspan="6">Accelerators-Retarders- Plasticizers- Super plasticizers- Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline -Their effects on concrete properties.</td></tr>
<tr><td>UNIT III</td><td colspan="4">PROPORTIONING & PROPERTIES OF CONCRETE</td><td>9</td></tr>
<tr><td colspan="6">Design Mix and Nominal Mix-BIS Method of Mix Design - Mix Design Examples- Workability-Tests for workability of concrete-Slump Test and Compacting factor Test-Segregation and Bleeding-Determination of Compressive and Flexural strength as per BIS - Properties of Hardened concrete- Stress-strain curve for concrete-Determination of Modulus of elasticity.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">DURABILITY OF CONCRETE</td><td>9</td></tr>
<tr><td colspan="6">Definitions - Deterioration processes – Physical, Chemical, Environmental & Biological; Measures for durability, Corrosion of reinforcing steel, protective measures. Durability issues in</td></tr>
</table>

concretes –carbonation – sulphate attack – chloride attack – permeability, Acid attack – Seawater attack etc.		
UNIT V	**SPECIAL CONCRETES**	**9**
Light weight concretes - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete - SIFCON - Shotcrete – Polymer concrete - High performance concrete- self compacting concrete - Geopolymer Concrete – No fines concrete –Cellular concrete.		
		TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Mix design of concrete as per IS methods for high performance concrete.
2. Fresh properties of concrete with relevance to workability.
3. Hardened properties of concrete with relevance to strength.
4. Flow Characteristics of Self Compacting concrete.
5. Non Destructive Test on hardened concrete-UPV, Rebound hammer and core test.
6. Durability tests on hardened concrete –Demonstration.

TOTAL: 15 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Demonstrate the requirements of cement, aggregates and water for concrete.
CO2:	Illustrate suitable admixtures for enhancing the properties of concrete.
CO3:	Develop concrete mixes as per IS method of mix design.
CO4:	Illustrate the properties of concrete at fresh and hardened state.
CO5:	Interpret the durability properties of concrete.
CO6:	Demonstrate the importance of special concretes for specific requirements.

TEXT BOOKS:	
1	Shetty.M.S., "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003.
2	Gupta.B.L., Amit Gupta., "Concrete Technology", Jain Book Agency, 2010.
REFERENCES:	
1	Neville, A.M., "Properties of Concrete", Pitman Publishing Limited, London, 1995.
2	Gambhir.M.., "Concrete Technology", Fifth Edition, McGraw Hill Education, 2017.
3	Job Thomas., "Concrete Technology", Cencage learning India Private Ltd, New Delhi, 2015.
4	IS 10262-2019, "Recommended Guidelines for Concrete Mix Design", Bureau of Indian Standards, New Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	1	1	1	1	2	2	1	1
2	2	1	-	-	1	2	2	2	1	1	1	2	2	1	2
3	3	2	1	1	1	-	2	2	-	-	1	2	3	1	2
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5	2	1	-	-	1	2	2	2	1	1	1	2	2	1	2
6	2	1	-	-	1	2	2	-	1	1	2	2	2	1	-
Overall Correlation	3	2	1	1	1	2	2	2	1	1	2	2	3	1	2

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23ME312	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Study about the properties of the fluids and behavior of fluids under static conditions.
- Gain basic knowledge of the dynamics of fluids and boundary layer concepts.
- Study the applications of the conservation laws to flow measurements, flow through pipes and forces on pipe bends.
- Learn the significance of boundary layer theory and its thicknesses.
- Study the basic principles of working and design of Pelton wheel, Francis and Kaplan turbine.
- Acquire knowledge on working principles of centrifugal, reciprocating and rotary pumps.

UNIT I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	9

Fluid Definition and Classification – Properties of fluids, Fluid statics - Pressure Measurements - Buoyancy and floatation - forces on submerged bodies, stability of floating bodies, Flow characteristics - Concept of control volume and system – Velocity potential and stream functions, Continuity equation, energy equation and momentum equation - Applications.

UNIT II	FLOW THROUGH PIPES AND BOUNDARY LAYER	9

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III	DIMENSIONAL ANALYSIS AND MODEL STUDIES	9

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters

- Similitude and model studies - Distorted and undistorted models.

UNIT IV	TURBINES	9

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V	PUMPS	9

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Determination of coefficient of discharge of a venture meter.
2. Determination of coefficient of discharge of an orifice meter.
3. Determination of friction factor for flow through pipes.
4. Determination of metacentric height.
5. Characteristics of centrifugal pumps.
6. Characteristics of reciprocating pump.
7. Characteristics of gear pump.
8. Characteristics of Pelton wheel turbine.
9. Flow measurement using Rotameter
10. Characteristics of Francis turbine.

TOTAL: 15 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply the conservation laws applicable to fluids and its application through fluid kinematics and dynamics and also to understand the properties and behavior of fluids in static conditions.
CO2:	Estimate the losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel.

CO3:	Apply the concept of boundary layer and its thickness on the flat solid surface.
CO4:	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.
CO5:	Calculate the power developed by the turbines.
CO6:	Calculate the efficiency of the different pumps.
TEXT BOOKS:	
1	Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 22nd edition (2019).
2	R K Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi.
3	Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House (p) Ltd. New Delhi, 2016.
REFERENCES:	
1	Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co., 2010.
2	Cengel Y A and Cimbala J M, "Fluid Mechanics", McGraw Hill Education Pvt. Ltd., 2014.
3	S K Som; Gautam Biswas and S Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Education Pvt. Ltd., 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	1	-	2	2	2	1	1	1
2	3	3	3	3	1	2	2	1	-	2	2	2	1	1	1
3	3	2	1	1	1	2	2	1	-	2	2	2	1	1	1
4	3	3	3	3	1	1	2	1	-	2	2	2	1	1	1
5	3	2	1	1	1	1	2	1	-	2	2	2	1	1	1
6	3	2	1	1	1	1	2	1	-	2	2	2	1	1	1
Overall Correlation	3	3	3	3	1	1	2	1	-	2	2	2	1	1	1

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23CE321	COMPUTER AIDED BUILDING DRAWING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To enable the students to draft the plan, elevation and sectional views of buildings.
- To encourage students to comply with development and control rules satisfying orientation and functional requirements as per National Building Code.

LIST OF EXPERIMENTS

1. Principles of planning and orientation.
2. Buildings with load bearing walls.
3. Buildings with sloping roof.
4. R.C.C. framed structures.
5. Industrial buildings – North light roof structures.
6. Building Information Modelling.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Illustrate the principles of planning.
CO2:	Build the plan, elevation and sectional view of load bearing buildings.
CO3:	Build the plan, elevation and sectional view of sloped roof buildings.
CO4:	Build the plan, elevation and sectional view of framed buildings.
CO5:	Build the plan, elevation and sectional view of industrial buildings.
CO6:	Illustrate the concepts of building information modelling.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	3	3	-	2	3	2	-	2	2	3	2
2	3	2	1	1	3	3	-	2	3	2	-	2	3	3	2
3	3	2	1	1	3	3	-	2	3	2	-	2	3	3	2
4	3	2	1	1	3	3	-	2	3	2	-	2	3	3	2
5	3	2	1	1	3	3	-	2	3	2	-	2	3	3	2
6	2	1	-	-	3	3	-	2	3	2	-	2	2	3	2
Overall Correlation	3	2	1	1	3	3	-	2	3	2	-	2	3	3	2

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23ES391	PRESENTATION SKILLS	L	T	P	C
		0	0	2	1*

COURSE OBJECTIVES:

- To help learners use brainstorming techniques for generating, organizing and outlining ideas.
- To familiarize learners with different speech structures by engaging them in watching speeches with great opening and closing
- To give practice on voice modulation and use of body language and eye contact for making captivating presentations
- To give hands on training on preparing presentation slides and using remote presentation tools
- To train students on responding to question and feedback with confidence.

UNIT I	BRAINSTORMING AND OUTLINING	6

Mind Mapping based on prior knowledge, collecting additional information from external resources, giving prompts to Generative AI tools seeking information, organizing ideas generated, knowing your audience.

UNIT II	STRUCTURING THE PRESENTATION	6

3 Ts of a presentation, writing effective introduction- Beginning the introduction with a hook (question, data, storytelling) and closing the introduction with the objective of the presentation. Structuring the body paragraphs -Choosing key ideas from the list of ideas generated during brainstorming. Substantiating ideas with examples, data, reasons and anecdotes. Summarizing the ideas for conclusion.

UNIT III	DELIVERY TECHNIQUES	6

Vocal variety, intonation, reducing filler words and improving articulation, inflection, engaging the audience. Body language- eye contact, gestures, movement on stage.

UNIT IV	USE OF TECHNOLOGICAL AIDS	6
Use of presentation software like MS Power Point, Google Slides etc, incorporating images, graphs, charts and videos, using interactive tools like quizzes and polls, using remote presentation tools like zoom, MS Teams, WebEx for screen sharing, virtual whiteboards and chat functionalities, incorporating AR/VR for more immersive presentations.		
UNIT V	**HANDLING QUESTIONS AND FEEDBACK**	**6**
Audience engagement through questions, PAR (Point, Answer, Redirect) strategy for structuring responses to questions. Understanding feedback process - Receiving, interpreting and evaluating constructively, active listening techniques for processing feedback, responding to feedback- acknowledging, clarifying and appreciating, Dealing with challenging feedback.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Construct ideas for presentation through mind mapping techniques.
CO2:	Organize ideas and structure the presentation with captivating introduction, body paragraphs illustrated with examples and reasons and compelling conclusion.
CO3:	Apply vocal variety and body language techniques to enhance delivery.
CO4:	Prepare engaging presentations by integrating multimedia elements.
CO5:	Demonstrate proficiency in delivering presentations in remote platforms utilizing various technological tools and strategies to engage audience in Virtual environments.
CO6:	Exhibit active listening skills by responding to questions with clarity and confidence and incorporating constructive feedback for professional development.

TEXT BOOKS:	
1	Nancy Duarte., "Slide: Ology: The Art and Science of Creating Great Presentations" O' Reilly Media.
2	Garr Reynolds., "The Naked Presenter: Delivering Powerful Presentations with or Without Slides" New Riders.
REFERENCES:	
1	Carmine Gallo., "Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds".

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
2	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
3	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
4	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
5	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
6	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
Overall Correlation	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**1**

Recommended by Board of Studies	**08-04-2024**		
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SEMESTER –IV

23MA401	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- Formulate and solve linear programming problems (LPP).
- Evaluate Transportation and Assignment Problems.
- Manage purchasing/manufacturing policies.
- Obtain solution to network problems using CPM and PERT techniques.
- Optimize the function subject to the constraints.

UNIT I	LINEAR PROGRAMMING MODELS	9+3

Introduction of Operations Research - mathematical formulation of LPP-Graphical Methods to solve LPP- Simplex Method- Big M method, Two phase method.

UNIT II	TRANSPORTATION PROBLEMS AND ASSIGNMENT PROBLEMS	9+3

Transportation problem (TP) - finding basic feasible solution of TP using North-West Corner Rule, Least Cost and Vogel's Approximation Method - MODI method for finding optimal solution for TP - Assignment problem - Hungarian method for solving Assignment problem - Travelling salesman problem as assignment problem – Production Scheduling problem – Introduction, Problems in single machine scheduling.

UNIT III	INVENTORY CONTROL	9+3

Introduction, Models – Problems in Purchase and Production (Manufacturing) models with and without shortages – Theory on types of inventory control systems: P& Q, ABC, VED, FNS, XYZ, SDE and HML.

UNIT IV	PROJECT MANAGEMENT	9+3

Project definition - Gantt chart - Project network - Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM.

UNIT V	CLASSICAL OPTIMIZATION THEORY	9+3

Unconstrained problems – necessary and sufficient conditions -

Newton-Raphson method, Constrained problems – equality constraints – inequality constraints - Kuhn-Tucker conditions.
TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Solve linear programming problems (LPP).
CO2:	Examine Transportation Problems.
CO3:	Examine Assignment Problems.
CO4:	Plan the purchase/ manufacturing policies to meet customer demands.
CO5:	Find solutions to network problems using CPM and PERT techniques.
CO6:	Optimize the function subject to the constraints.

TEXT BOOKS:

1	Hamdy A Taha., "Operations Research: An Introduction", Pearson, 10th Edition, 2017.
2	R. Pannerselvan., "Operations Research", 2nd Edition, PHI Publications, 2006.

REFERENCES:

1	Dontzig G.B, "Linear Programming and extensions", Princeton University Press.
2	ND Vohra., "Quantitative Techniques in Management", Tata McGraw Hill, 4th Edition, 2011.
3	J. K. Sharma., "Operations Research Theory and Applications", Macmillan, 5th Edition, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3		
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE401	TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
• To give an overview about the highway, railway, airport and harbour engineering with respect to, planning, design, construction and maintenance as per standards, specifications and methods.					
UNIT I	**HIGHWAY ENGINEERING**				**9**
Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment –Typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method.					
UNIT II	**HIGHWAY CONSTRUCTION AND MAINTENANCE**				**9**
Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage – Evaluation and Maintenance of pavements – Expressways.					
UNIT III	**RAILWAY PLANNING AND CONSTRUCTION**				**9**
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signaling – Metrorail and Monorail.					
UNIT IV	**AIRPORT PLANNING AND COMPONENTS**				**9**
Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area -Airport Classification, Planning of					

Airfield Components – Runway, Taxiway, Apron, Hangar - Passenger Terminals- Airport drainage.		
UNIT V	**SEAPORTS COMPONENTS AND CONSTRUCTION**	**9**
Definition of Basic Terms: Harbour, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids- Inland Water Transport.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate highway according to the principles and standards adopted in various institutions in India.
CO2:	Interpret highway materials and construction practice methods and know its properties and able to perform pavement evaluation and management.
CO3:	Summarize the elements in railway planning and constructions.
CO4:	Demonstrate knowledge of the planning and site selection of airport Planning.
CO5:	Outline the various components in dock, port and harbour.
CO6:	Illustrate the various features in coastal structures.
TEXT BOOKS:	
1	Subramanian. K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.
2	C. Venkatramaiah., "Transportation Engineering - Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels", Universities Press (India) Private Limited, Hyderabad, 2015.

REFERENCES:

1	Indian Road Congress (IRC), “Guidelines for the Design of Flexible Pavements”, (Third Revision), IRC: 37-2012.
2	Indian Road Congress (IRC), “Guidelines for the Design of Plain Jointed Rigid Pavements for Highways”, (Third Revision), IRC: 58-2012.
3	Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Ninth Impression, South Asia, 2012.
4	Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, 1st Edition, USA, 2011.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
2	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
3	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
4	2	1	-	-	-	1	-	1	-	-	-	1	2	-	1
5	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
6	2	1	-	-	-	1	-	-	-	-	-	1	2	-	-
Overall Correlation	2	2	1	1	-	1	-	1	-	-	-	1	2	-	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE402	WATER SUPPLY AND WASTE WATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students to various components and design of water supply scheme, water treatment methods, water storage distribution system, sewage treatment and disposal and deign of intake structures and sewerage system.

UNIT I	WATER SUPPLY	9

Estimation of surface and subsurface water resources - Predicting demand for water- Impurities of water and their significance - Physical, chemical and bacteriological analysis - Waterborne diseases -Standards for potable water. Intake of water: Pumping and gravity schemes.

UNIT II	WATER TREATMENT	9

Objectives - Unit operations and processes - Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation – Clariflocculator - Plate and tube settlers - Pulsator clarifier - sand filters - Disinfection - softening, removal of iron and manganese - Defluoridation - Softening - Desalination process - Residue Management - Construction, Operation and Maintenance aspects.

UNIT III	WATER STORAGE AND DISTRIBUTION	9

Storage and balancing reservoirs - types, location and capacity. Distribution system: layout, hydraulics of pipe lines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems, leak detection, maintenance of distribution systems, pumping stations and their operations - House service connections.

UNIT IV	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 drainage-Storm runoff estimation - Sewer appurtenances - Corrosion in sewers - Prevention and control – Sewage pumping-drainage in buildings - Plumbing systems for drainage.		
UNIT V	**SEWAGE TREATMENT AND DISPOSAL**	**9**
Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended aeration systems - Trickling filters - Sequencing Batch Reactor(SBR) - UASB - Waste Stabilization Ponds - Other treatment methods - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance aspects. - Discharge standards-sludge treatment -Disposal of sludge.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the various components of water supply scheme, sources and characteristics of water and its intake and pumping schemes.
CO2:	Interpret the functions and operation of water treatment plant, sedimentation tank design and residue management.
CO3:	Classify the process of water storage system, and choose the reservoir types based on the location and capacity.
CO4:	Choose the water distribution system and water supply in buildings.
CO5:	Develop the sanitary sewage flow and population equivalent to design sewerage system.
CO6:	Construct the various advanced treatment of sewage system and discharge standards for sludge treatment and disposal.
TEXT BOOKS:	
1	Garg, S.K., “Environmental Engineering”, Vol.I & Vol.II, Khanna Publishers, New Delhi, 2010.

2	Modi, P.N., “Water Supply Engineering”, Vol.I, Standard Book House, New Delhi, 2016.
REFERENCES:	
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, 1999.
3	Metcalf and Eddy, “Waste water Engineering – Treatment and Reuse”, Tata Mc. Graw Hill Company, New Delhi, 2010.
4	Syed R.Qasim, “Waste water Treatment Plants”, RC Press, WashingtonD.C.,2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	-	-	1	2	1	1
2	2	1	-	-	1	1	-	1	1	1	-	1	2	1	1
3	2	1	-	-	1	1	1	1	1	-	-	1	2	1	1
4	3	2	1	1	1	1		1	1	1	-	1	3	1	1
5	3	2	1	1	1	1	2	1	1	1	-	1	3	1	1
6	3	2	1	1	1	1	1	1	1	1	-	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	-	1	3	1	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE411	SOIL MECHANICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.
- To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of soils.
- To impart knowledge of design of both finite and infinite slopes.

UNIT I	SOIL CLASSIFICATION AND COMPACTION	9

Formation of soil - Soil description – Particle – Size shape and colour – Composition of gravel, sand, silt, clay particles – Particle behaviour – Soil structure – Phase relationship – Index properties – Significance – BIS classification system – Unified classification system – Compaction of soils – Theory, Laboratory and field tests – Field Compaction methods – Factors influencing compaction of soils.

UNIT II	EFFECTIVE STRESS AND PERMEABILITY	9

Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Permeability interaction – Hydraulic conductivity – Darcy's law – Determination of Hydraulic Conductivity – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two dimensional flow – Laplace's equation – Introduction to flow nets – Simple problems. (Sheet pile and weir).

UNIT III	**STRESS DISTRIBUTION AND SETTLEMENT**	**9**
Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point load, Line load and udl) Use of New marks influence chart – Components of settlement – Immediate and consolidation settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. - √t and log t methods – e-log p relationship.		
UNIT IV	**SHEAR STRENGTH**	**9**
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Cyclic mobility – Liquefaction.		
UNIT V	**SLOPE STABILITY**	**9**
Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices – Fellenious and Bishop's method - Slope protection measures.		
		TOTAL: 45 PERIODS
LIST OF EXPERIMENTS:		

1. **DETERMINATION OF INDEX PROPERTIES**
   a. Specific gravity of soil solids.
   b. Grain size distribution – Sieve analysis.
   c. Grain size distribution - Hydrometer analysis.
   d. Liquid limit and Plastic limit tests.
   e. Shrinkage limit and Differential free swell tests.
2. **DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS**
   a. Field Density Test (Sand replacement method).
   b. Determination of moisture–density relationship using standard proctor compaction test.
3. **DETERMINATION OF ENGINEERING PROPERTIES**
   a. Permeability determination (constant head and falling head methods).

	b. One-dimensional consolidation test (Determination of co-efficient of consolidation only). c. Direct shear test in cohesion less soil. d. Unconfined compression test in cohesive soil. e. Laboratory vane shear test in cohesive soil. f. Tri-axial compression test in cohesion-less soil (Demonstration only). g. California Bearing Ratio Test. **4. TEST ON GEOSYNTHETICS (Demonstration only)** a. Determination of tensile strength and interfacial friction angle. b. Determination of apparent opening sizes and permeability. **TOTAL:15 PERIODS**
	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Apply soil classification principles to categorize different soil types and assess their engineering properties using index properties.
CO2:	Apply the concepts of soil-water interactions, including static pressure, effective stress, capillary phenomena, and permeability, to real-world engineering problems.
CO3:	Apply stress distribution theories and determine the stresses at various depth of soil layers.
CO4:	Apply Terzaghi's theory to solve consolidation problems, and also determine the settlement components.
CO5:	Apply the Mohr-Coulomb theory to estimate shear strength of soils.
CO6:	Apply stability analysis methods to estimate stability of infinite and finite slopes.
TEXT BOOKS:	
1	Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2015.

2	Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2006.
REFERENCES:	
1	McCarthy, D.F., "Essentials of Soil Mechanics and Foundations", Prentice-Hall, 2006.
2	Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi, 2010.
3	Das, B.M., "Principles of Geotechnical Engineering". Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013.
4	Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	1	1	1	-	-	1	3	1	1
2	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
3	3	2	1	1	1	-	1	1	1	-	-	1	3	1	1
4	3	2	1	1	-	-	-	1	1	1	-	1	3	-	1
5	3	2	1	1	-	1	2	1	1	1	-	1	3	-	1
6	3	2	1	1	1	1	1	1	1	2	-	1	3	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	-	1	3	1	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE412	STRENGTH OF MATERIALS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9+3

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants, Poisson's ratio – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle for plane stress.

UNIT II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAMS	9+3

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Shear stress distribution.

UNIT III	DEFLECTION OF BEAMS	9+3

Double Integration method – Macaulay's method – Area moment method - Conjugate beam method for computation of slopes and deflections in determinate beams.

UNIT IV	TORSION, SPRINGS AND COLUMNS	9+3
Theory of Torsion - Stresses and deformations in solid and hollow circular shafts – Stepped shafts – Power transmitted by a shaft. Helical springs – Differences between closely coiled and open coiled helical springs – Closely coiled helical springs – Calculation of shear stress, deflection and stiffness. Columns – Euler's theory – Calculation of crippling load for different end conditions for a long column.		
UNIT V	**THIN CYLINDERS, SPHERES AND THICK CYLINDERS**	**9+3**
Stresses in thin and thick cylindrical shell, deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells.		
		TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

7. Tension test on mild steel rod
8. Double shear test on mild steel rod
9. Torsion test on mild steel rod
10. Izod Impact test on metal specimen
11. Charpy Impact test on metal specimen
12. Rockwell Hardness test on metals
13. Brinell Hardness test on metals
14. Compression test on helical spring
15. Heat Treatment Processes- Annealing, Normalizing, Quenching and Tempering
16. Jominy End Quench Test

TOTAL:15 PERIODS

COURSE OUTCOMES:

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

CO1	Calculate the different stresses developed in the solids when subjected to different loading conditions.
CO2	Analyse the shear force and bending moment diagrams of the beams under the various loading conditions.
CO3	Examine the bending stress and shear stress distribution of various sections of the beam.

CO4	Calculate the slope and deflection of beams using different methods.
CO5	Apply the basic equations to design shafts, springs and columns.
CO6	Calculate the stresses developed in the thin cylinder, thick cylinder, and spherical shells.
TEXT BOOKS:	
1	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016.
2	Rattan S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
REFERENCES:	
1	Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand and Company Ltd., New Delhi, 7th edition, 2018.
2	Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.
3	Beer. F.P. and Johnston. E.R. "Mechanics of Materials", Tata McGraw Hill, 8th Edition, New Delhi 2019.
4	Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
2	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
3	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
4	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
5	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
6	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-
Overall Correlation	3	2	1	1	1	1	-	-	2	-	-	-	3	1	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23CE421	WATER AND WASTE WATER ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- This subject includes the list of experiments to be conducted for characterization of water and municipal sewage. At the end of the course, the student is expected to be aware of the procedure for quantifying quality parameters for water and sewage.

LIST OF EXPERIMENTS:

1. Sampling and preservation methods for water and waste water (Demonstration only).
2. Measurement of Electrical conductivity and turbidity.
3. Determination of fluoride in water by spectrophotometric method / ISE.
4. Determination of iron in water.
5. Determination of Sulphate in water.
6. Determination of Phosphates in water.
7. Determination of Optimum Coagulant Dosage by Jar test apparatus.
8. Determination of available Chlorine in Bleaching powder and residual chlorine in water.

ANALYSIS OF WASTEWATER SAMPLE

9. Estimation of suspended, volatile and fixed solids.
10. Determination of Sludge Volume Index in waste water.
11. Determination of Dissolved Oxygen.
12. Estimation of B.O.D.
13. Estimation of C.O.D.
14. Determination of TKN and Ammonia Nitrogen in wastewater.
15. Determination of total and faecal coliform (Demonstration only).

TOTAL : 30 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Select the calibration and standardize the equipment.
CO2:	Choose proper sample for analysis.
CO3:	Choose the sample preservation methods.
CO4:	Experiment with field oriented testing of water.
CO5:	Experiment with field oriented testing of wastewater.
CO6:	Apply coliform analysis.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	1	1	2	1	-	1	1	3	2	2
2	3	2	1	1	2	1	-	2	1	1	1	1	3	2	2
3	3	2	1	1	2	1	1	2	1	1	1	1	3	2	2
4	3	2	1	1	2	1		2	1	1	1	1	3	2	2
5	3	2	1	1	2	1	2	2	1	1	1	1	3	2	2
6	3	2	1	1	2	1	1	2	1	1	1	1	3	2	2
Overall Correlation	3	2	1	1	2	1	1	2	1	1	1	1	3	2	2

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23ES491	APTITUDE AND LOGICAL REASONING – 1	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:	
• To improve the problem solving and logical thinking ability of the students. • To acquaint student with frequently asked questions and patterns in quantitative aptitude and logical reasoning.	
UNIT I	**4**
Numbers, LCM, HCF, Averages, Ratio & Proportion, Mixtures & Allegation.	
UNIT II	**4**
Percentages, Time and work, Pipes and Cistern, coding and decoding.	
UNIT III	**4**
Time Speed Distance, Train, Boats and Streams, Analogy.	
UNIT IV	**4**
Data Interpretation (BAR,PIE,LINE), Seating arrangement.	
UNIT V	**4**
Simple Interest and Compound Interest, Profit loss and Discount, Partnership.	
	TOTAL: 20 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyse and solve complex problems, and foster critical thinking and logical reasoning skills.
CO2:	Solve fundamental mathematical problems, and enhance their computational skills and numerical ability.
CO3:	Develop strategies for tackling a variety of problem types, and encourage the use of multiple approaches to solve problems efficiently.
CO4:	Analyse and solve different data analysis problems for time and distance, and interpret data analysis for a case study.
CO5:	Derive information from graphs, and solve questions based on mathematical operations such as ratios, proportions, basic algebra, and statistical estimation.
CO6:	Solve questions in a fraction of a minute using shortcut methods

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing

Cos	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	-	-	2	1	1	2	1	2	3	1	-	3
2	2	3	3	-	-	2	-	1	3	2	2	3	2	1	3
3	3	3	3	-	-	2	-	1	2	2	2	3	2	-	3
4	2	3	2	3	-	2	1	2	3	3	2	3	1	2	3
5	3	2	2	-	1	3	-	2	2	3	3	3	3	1	3
6	3	3	3	3	2	3	1	3	3	2	3	3	3	1	3
Overall Correlation	3	3	3	1	1	3	1	2	3	3	3	3	2	1	3

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

SEMESTER -V

		L	T	P	C
23RE501	**RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To provide an overview on selection of research problem based on the Literature review.
- To enhance knowledge on the Data collection and analysis.
- To outline the importance of ethical principles to be followed in Research work and IPR.

UNIT I	**INTRODUCTION TO RESEARCH FORMULATION**	**6**

Meaning of research problem, Sources of research problem, Criteria - good research problem, and selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Necessity of defining the problem - Importance of literature review in defining a problem.

UNIT II	**LITERATURE REVIEW**	**6**

Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

UNIT III	**DATA ANALYSIS**	**6**

Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation.

UNIT IV	**REPORT, THESIS PAPER, AND RESEARCH PROPASAL WRITING**	**6**

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports –

Illustrations and tables - Bibliography, types of referencing, citations - index and footnotes, how to write report - Paper Developing, - Plagiarism- Research Proposal - Format of research proposal- a presentation - assessment by a review committee.

UNIT V	**INTELLECTUAL PROPERTY AND PATENT RIGHTS**	**6**

Ethical principles- Plagiarism, Nature of Intellectual Property - Patents, Designs, Trade and Copyright- patent search, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of Patent Rights – Scope of Patent Rights, Geographical Indications.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze the literature to identify the research gap in the given area of research.
CO2:	Identify and formulate the research Problem.
CO3:	Analyze and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.
CO4:	Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report.
CO5:	Conduct patent database search in various countries for the research problem identified.
CO6:	Apply ethical principles in research and reporting to promote healthy scientific practice.

TEXT BOOKS:

1	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., "An Introduction to Research Methodology", RBSA Publishers, 2002.
2	Kothari, C.R., "Research Methodology: Methods and Techniques", New Age International. 418p, 1990.

3	Sinha, S.C. and Dhiman, A.K., "Research Methodology", Ess Ess Publications, 2 volumes, 2002.
4	Trochim, W.M.K., "Research Methods: the concise knowledge base", Atomic Dog Publishing. 270p, 2005.
5	Wadehra, B.L., "Law relating to patents, Trade Marks, Copy right designs and Geographical indications", Universal Law Publishing, 2000.
REFERENCES:	
1	Anthony, M., Graziano, A.M. and Raulin, M.L., "Research Methods: A Process of Inquiry", Allyn and Bacon, 2009.
2	Carlos, C.M., "Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options", Zed Books, New York, 2000.
3	Coley, S.M. and Scheinberg, C. A., "Proposal Writing", Sage Publications, 1990.
4	Day, R.A., "How to Write and Publish a Scientific Paper", Cambridge University Press, 1992.
5	Fink, A., "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.
6	Leedy, P.D. and Ormrod, J.E., "Practical Research: Planning and Design", Prentice Hall, 2004
7	Satarkar, S.V., "Intellectual property rights and copy right", Ess Ess Publications, 2000.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
2	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
3	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
4	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
5	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
6	2	2	1	1	1	-	-	1	1	2	-	1	3	2	1
Overall Correlation	3	2	**1**	**1**	**1**	**-**	**-**	**1**	**1**	2	**-**	**1**	**3**	**2**	**1**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE501	DESIGN OF REINFORCED CONCRETE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the different methods of designing a reinforced concrete elements subjected to wind and seismic loading.
- To understand the limit state design of flanged beams and rectangular beams under combined action of bending, shear and torsion.
- To learn the concept of designing different types of slabs and dog – legged stair case.
- To effectively use design aids to design columns subjected to different bending conditions.
- To outline the design philosophies of footing for different loading as per Codal provisions.

UNIT I	INTRODUCTION	9

Objective of structural design – Types of Loads and Load combinations – Concept of Elastic method, Ultimate Load method and Limit State method – Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly reinforced rectangular beams by limit State Method – Calculation of Wind load for G+3 building as per IS 800:2007 – Base shear calculation for G+2 building as per IS 1893:Part I-2016.

UNIT II	LIMIT STATE METHOD - FLANGED BEAM, SHEAR & TORSION	9

Analysis and design of flanged beams – Use of design aids for Flexure - Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion - serviceability.

UNIT III	**LIMIT STATE DESIGN OF SLABS AND STAIRCASE**	**9**
Analysis and design of cantilever, one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions - Types of Staircases – Design of dog-legged staircase – Introduction to Flat Slab.		
UNIT IV	**LIMIT STATE DESIGN OF COLUMNS**	**9**
Types of columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending using Design aids.		
UNIT V	**LIMIT STATE DESIGN OF FOOTING**	**9**
Design of wall footing – Design of axially and eccentrically loaded rectangular pad and sloped footings – Design of combined rectangular footing for two columns only.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Analyze the reinforcement for RC beams and evaluate the of Wind and Seismic loads on Concrete Structures using Limit state method of design.
CO2:	Analyze the reinforcement for flanged beams under bending and shear.
CO3:	Analyze reinforcement for reinforced concrete beam subjected to combined bending, shear and torsion.
CO4:	Analyze the reinforcement for reinforced concrete slabs and dog-legged staircase as per Codal provisions.
CO5:	Analyze the reinforcement for short columns under axial, uni-axial and bi-axial eccentric loadings.
CO6:	Analyze the reinforcement for wall footings, isolated footings and combined rectangular footing.

TEXT BOOKS:	
1	Unnikrishna Pillai and Devdass Menon., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2021.
2	Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, Pvt. Ltd., New Delhi, 2015.
REFERENCES:	
1	Dr.Ramachandra., “Limit state Design of Concrete Structures“, Standard Book House, New Delhi, 2018.
2	Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”, Laxmi Publication Pvt. Ltd., New Delhi, 2016.
3	Dr. Vinod Hosur., “Earthquake-Resistant Design of Building Strucutres”, Wiley Precise Textbooks, India, 2013.
4	Ramamrutham S., “Design of Reinforced Concrete Structures” Dhanpat Rai, New Delhi, 2015 (Reprint).

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
2	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
3	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
4	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
5	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
6	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2
Overall Correlation	3	3	2	2	1	1	1	2	1	1	2	1	3	1	2

Recommended by Board of Studies	08-11-2024		
Approved	3rd ACM	Date	30-11-2024

23CE502	STRUCTURAL ANALYSIS - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts to analyze the indeterminate beams.
- To understand the slope deflection method to analyze the continuous beams and frames.
- To understand the moment distribution method to analyze the continuous beams and frames.
- To understand the concepts of flexibility method to analyze the beams and frames.
- To develop the concepts of stiffness method to analyze the beams and frames.

UNIT I	INDETERMINATE BEAMS	9

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 II	SLOPE DEFLECTION METHOD	9

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements - Symmetric frames with symmetric and skew - Symmetric loadings.

UNIT III	MOMENT DISTRIBUTION METHOD	9

Stiffness - Distribution and carry over factors – Analysis of continuous Beams - Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew - Symmetric loadings.

UNIT IV	FLEXIBLITY METHOD	9

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 V	**STIFFNESS METHOD**	**9**
Restrained structure –Formation of stiffness matrices - Equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Analyze propped cantilever, fixed beams and continuous beams for external loadings and support settlements.	
CO2:	Analyze the continuous beams and rigid frames by slope defection method.	
CO3:	Analyze the continuous beams by moment distribution method.	
CO4:	Apply the concept of moment distribution and analysis of rigid frames with and without sway.	
CO5:	Analyze the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.	
CO6:	Develop the concept of matrix stiffness method and analyze the continuous beams, pin jointed trusses and rigid plane frames.	
TEXT BOOKS:		
1	Bhavikatti, S.S, "Structural Analysis", Vol. 1 & 2, Vikas Publishing House Pvt.Ltd., New Delhi-4, 2014.	
2	Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of Structures", Laxmi Publications, New Delhi, 2004.	
REFERENCES:		
1	William Weaver, Jr and James M.Gere, "Matrix Analysis of Framed Structures", CBS Publishers & Distributors, Second Edition, Delhi, 2004.	

2	Reddy.C.S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.
3	Negi L.S. and Jangid R.S., “Structural Analysis”, Tata McGraw Hill Publishing. Co. Ltd. 2004.
4	Bhavikatti, S.S, “Matrix Method of Structural Analysis”, I. K. International Publishing House Pvt.Ltd., New Delhi-4, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	1	1	1	-	-	1	1	3	-	1
2	3	3	2	2	-	1	1	1	-	-	1	1	3	-	1
3	3	3	2	2	-	1	1	1	-	-	1	1	3	-	1
4	3	2	1	1	-	1	1	1	-	-	1	1	3	-	1
5	3	3	2	2	-	1	1	1	-	-	1	1	3	-	1
6	3	2	1	1	-	1	1	1	-	-	1	1	3	-	1
Overall Correlation	3	3	2	2	-	1	1	1	-	-	1	1	3	-	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE503	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the Soil exploration Techniques.
- To impart knowledge in the settlement components of foundation.
- To understand the methods of proportioning different types of footings.
- To comprehend design principles of pile foundation.
- To understand the effect of lateral earth pressures on retaining walls.

UNIT I	SOIL EXPLORATION	9

Need – Methods of soil exploration – Boring and sampling methods – Penetration tests – Plate load test – Planning of soil exploration, Bore logs and preparation of soil investigation report.

UNIT II	SHALLOW FOUNDATION	9

Types - Choice of foundation – Location and depth - Safe bearing capacity – Shear criteria – Terzaghi's, and IS code methods - Settlement criteria – Allowable bearing pressure based on SPT N value and plate load test – Allowable settlements of structures.

UNIT III	FOOTINGS	9

Types of Isolated footing, Contact pressure and settlement distribution for flexible and rigid footings, Combined footing – Types, Applications and Proportioning; Mat foundation - Proportioning by conventional rigid behavior method – Minimum depth for rigid behaviour – Applications – Floating foundation – Special foundations – Seismic force consideration – Codal provision.

UNIT IV	PILE FOUNDATION	9

Types of piles – Load carrying capacity of piles based on static pile formulae – Dynamic pile formulae – Pile Capacity through SPT

results - Pile load tests –Pile under lateral loading - load carrying capacity of pile groups in sands and clays – Settlement of pile groups – Negative skin friction.		
UNIT V	**EARTH PRESSURE THEORIES AND RETAINING WALLS**	**9**
Active, Passive and at rest soil pressures, Rankine's theory of earth pressure - Earth pressures in layered soils – Coulomb's earth pressure theory - Types of retaining walls – Stability of gravity and cantilever retaining walls against overturning, sliding and bearing capacity, filter material for drainage.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Illustrate the principles and methods of Geotechnical Exploration.
CO2:	Analyze the safe bearing capacity of shallow foundations.
CO3:	Estimate the foundation settlement by analyzing the relevant data.
CO4:	Analyze the Load Carrying Capacity of Pile Foundation.
CO5:	Analyze capacity and settlement characteristics of pile groups.
CO6:	Determine the earth pressure on retaining wall by analyzing soil characteristics.
TEXT BOOKS:	
1	Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2	Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.
REFERENCES:	
1	Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
2	Gopal Ranjan, A S R Rao, "Basic and Applied Soil

	Mechanics" New Age International Publication, 3rd Edition, 2016.
3	Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017.
4	Braja M Das, "Principles of Foundation Engineering" (Eighth edition), Cengage Learning 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	1	-	-	-	1	2	2	1	-
2	3	3	2	2	2	1	2	2	2	-	-	2	3	2	2
3	3	3	3	3	-	-	-	1	-	1	1	2	3	-	1
4	3	3	2	2	2	1		1	2	1	-	2	3	2	1
5	3	3	2	2	-	1	2	1	2	-	-	2	3	-	1
6	3	2	1	1	-	1	1	-	-	-	1	2	2	-	-
Overall Correlation	3	3	2	2	1	1	1	1	1	1	1	2	3	1	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE521	COMPUTER AIDED DESIGN AND DETAILING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To introduce the loading requirements for cantilever and counterfort retaining wall.
- To acquire knowledge on analysis and design of dog-legged stair case.
- To understand the behaviour of water tanks for storing liquids.
- To analyse and design a multi storey building using STAAD Pro.
- To illustrate the detailing of retaining wall, bridges, water tanks and multi-storey buildings.

LIST OF EXPERIMENTS:

1. Design and drawing of RCC cantilever and counter fort type retaining walls with reinforcement details.
2. Design of solid slab and RCC Tee beam bridges for IRC loading and reinforcement details.
3. Design and drafting of circular and rectangular RCC water tanks.
4. Design of dog-legged staircase.
5. Analysis and design of Multi Storey Building using STAAD Pro.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1:	Analyze, design and detail cantilever retaining wall using STAAD Pro and AutoCAD.
CO2:	Analyze, design and detail counterfort retaining wall using STAAD Pro and AutoCAD.
CO3:	Apply IRC loading to design reinforced cement concrete Tee-beam bridge.
CO4:	Analyze the reinforcement details of circular and rectangular RCC water tanks.

CO5:	Analyze a dog-legged staircase using STAAD Pro.
CO6:	Analyze and design multi-storey building for wind and earthquake loading using STAAD Pro.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1
2	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1
3	3	2	1	1	2	1	-	1	2	-	1	2	3	2	1
4	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1
5	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1
6	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1
Overall Correlation	3	3	2	2	2	1	-	1	2	-	1	2	3	2	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE522	SURVEY CAMP	L	T	P	C
		0	0	0	2

COURSE OBJECTIVES:

- To learn the practical aspects of surveying and its instruments in the field.
- To develop a group of not more than six members will carry out each exercise in survey camp.
- To determine mapping of points and contouring the given area in the field.
- To prepare a camp record and it shall include all original field observations, calculations and plots.

EXPERIMENTS:

1. Traverse – using Theodolite / Total station.
2. 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 L.S at Every 30M and C.S at every 90 M.
3. Offset of Buildings and Plotting the Location.
4. Use of GPS to determine latitude and longitude and locate the survey camp location.
5. Traversing using GPS.
6. Curve setting by deflection angle.

Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

DURATION: 2 WEEKS

COURSE OUTCOMES:

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

CO1:	Interpret the modern surveying instruments like Total station and GPS.

CO2:	Apply modern surveying techniques in field to establish horizontal control.
CO3:	Apply the surveying techniques in field to establish vertical control.
CO4:	Apply different survey adjustment techniques.
CO5:	Apply different setting outworks in the field.
CO6:	Apply surveying techniques in field observations, calculations and plots.

TEXT BOOKS:

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	1	2	1	-	2	3	2	1
2	3	2	1	1	2	2	-	1	2	1	-	-	3	2	1
3	3	2	1	1	2	2	-	1	2	-	-	-	3	2	1
4	3	2	1	1	2	2	-	1	2	-	-	-	3	2	1
5	3	2	1	1	2	2	-	1	2	-	-	-	3	2	1
6	3	2	1	1	2	2	-	1	2	1	-	2	3	2	1
Overall Correlation	3	2	1	1	2	2	-	1	2	1	-	2	3	2	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE523	DESIGN PROJECT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To use the knowledge acquired in Civil Engineering to impart and improve the design capabilities of the students.

STRATEGY

This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection etc. The design problem can be allotted to either an individual student or a group of students comprising of not more than four. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and a complete set of drawings which follow the design. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Identify the design problem in Civil engineering disciplines.
CO2:	Develop the methodology to solve the design problem in Civil engineering disciplines.
CO3:	Model graphically the plan of the design problem in Civil engineering disciplines.
CO4:	Model the components for the design problem in Civil engineering disciplines.
CO5:	Analyze the components for the design problem in Civil engineering disciplines.
CO6:	Categorize and detail the components for the design problem in Civil engineering disciplines.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	1	1	2	1	2	3	3	2	2
2	3	2	1	1	1	2	1	1	2	1	2	3	3	2	2
3	3	2	1	1	2	2	1	2	2	1	2	3	3	2	2
4	3	2	1	1	2	2	1	1	2	1	2	3	3	2	2
5	3	3	2	2	2	2	1	2	2	1	2	3	3	2	2
6	3	3	2	2	2	2	1	2	2	1	2	3	3	2	2
Overall Correlation	3	3	2	2	2	2	1	2	2	1	2	3	3	2	2
Recommended by Board of Studies							**08-11-2024**								
Approved							**3rd ACM**			**Date**			**30-11-2024**		

23ES591	APTITUDE AND LOGICAL REASONING –2	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint the student with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews

UNIT I		**4**
Probability, Permutation & Combination, Algebra, Problems on ages		
UNIT II		**4**
Mensuration, Logarithms, inequalities and modulus, Syllogism		
UNIT III		**4**
Directions, logical sequence words, number series, Analytical Reasoning		
UNIT IV		**4**
Blood relation, Clock and Calendar, Picture puzzles		
UNIT V		**4**
Data sufficiency, cube and cuboids, odd man out		
		TOTAL: 20 PERIODS

COURSE OUTCOMES:

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

CO1:	Apply concepts of probability, permutation, and combination to solve real-world problems.
CO2:	Solve algebraic problems and age-related problems using logical approaches and techniques.
CO3:	Analyze and solve problems in mensuration, logarithms, and inequalities.
CO4:	Interpret and solve problems related to directions, logical sequence, and number series.
CO5:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.
CO6:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	3	2	2	2	1	3	1	2	3	2	2
2	3	2	2	2	3	2	3	2	1	2	1	2	3	2	3
3	3	3	2	2	2	2	2	2	1	3	1	2	3	3	2
4	2	3	2	1	2	3	1	2	3	3	2	3	2	2	3
5	2	3	3	2	2	2	2	3	2	2	2	3	3	3	3
6	3	3	2	2	3	2	3	3	2	2	1	2	3	3	2
Overall Correlation	3	3	3	2	3	3	3	3	2	3	2	3	3	3	3

Recommended by Board of Studies	**13-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER –VI

23CE601	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the limit state design of structural steel connections.
- To know the behaviour of tension members under loading and design tension members effectively.
- To be familiar with the behaviour of long and short columns, and design the compression members with lacings and battens.
- To understand the design principles of steel beams and plate girders.
- To apply wind load provisions of current code in order to design roof truss components and understand pre-engineered buildings.

UNIT I	INTRODUCTION TO STRUCTURAL STEEL AND DESIGN OF CONNECTIONS	9

General -Types of Steel -Properties of structural steel - I.S. rolled sections - Concept of Limit State Design - Design of Simple and eccentric Bolted and welded connections - Types of failure and efficiency of joint – Prying action - Introduction to HSFG bolts.

UNIT II	DESIGN OF TENSION MEMBERS	9

Types of sections – Net area – Net effective sections for angles and Tee in tension-Behaviour and Design of simple and built-up members subjected to tension - Shear lag effect - Design of lug angles - Tension splice.

UNIT III	DESIGN OF COMPRESSION MEMBERS	9

Behaviour of short and long columns - Euler's column theory - Design of simple and built - up compression members with lacings and battens - Design of column bases - Slab base and gusseted base.

UNIT IV	**DESIGN OF BEAMS**	**9**
Design of laterally supported and unsupported beams - Design of built-up beams - Design of plate girders.		
UNIT V	**INDUSTRIAL STRUCTURES**	**9**
Design of roof trusses – Loads on trusses – Purlin design using angle and channel sections – Truss design, Design of joints and end bearings – Gantry girders – Design Considerations - Introduction to Pre-Engineered buildings.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the design philosophy of steel structures and estimate the design strength of bolted and welded connections.
CO2:	Analyze the behavior of tension members and design tension splices and lug angles.
CO3:	Analyze the behavior of compression members and design the compression members with lacings and battens.
CO4:	Examine the behavior of laterally supported and unsupported flexural members and design plate girders.
CO5:	Analyze the components of roof trusses.
CO6:	Summarize the design philosophy of gantry girders & introduce to pre-engineered buildings.
TEXT BOOKS:	
1	Duggal S.K., “Design of Steel Structures”, Tata McGraw Hill, Publishing Co. Ltd., New Delhi, 2010.
2	Bhavikatti S.S, “Design of Steel Structures”, IK International Publishing House, New Delhi, 2017.
REFERENCES:	
1	Gambhir M L, “Fundamentals of Structural Steel Design”, McGraw Hill Education India Pvt Limited, 2013.
2	Jack C. McCormac and Stephen F Csernak, “Structural Steel Design”, Pearson Education Limited, 2013.

3	Sarwar Alam Raz, “Structural Design in Steel”, New Age International Publishers, 2014.
4	Subramanian N, “Design of Steel Structures”, Oxford University Press, New Delhi, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	-	-	1	2	3	1	1
2	3	3	2	2	1	1	-	1	-	-	1	2	3	1	1
3	3	3	2	2	1	1	-	1	-	-	1	2	3	1	1
4	3	3	2	2	1	1	1	1	-	-	1	2	3	1	1
5	3	3	2	2	-	1	1	1	-	-	2	2	3	-	1
6	2	1	-	-	-	1	1	1	-	-	1	2	3	-	1
Overall Correlation	3	3	2	2	1	1	1	1	-	-	2	2	3	1	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE602	STRUCTURAL ANALYSIS - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the method of drawing influence lines and its applications.
- To understand the Muller Breslau's principal for the analysis of the indeterminate structures.
- To understand the Eddy's theorem for the analysis of the arches.
- To understand the concepts of suspension bridges and space truss.
- To apply the concept of plastic analysis in beams and frames.

UNIT I	INFLUENCE LINES FOR DETERMINATE STRUCTURES	9

Introduction to moving loads, Concept of Influence Lines, Influence lines for reactions in statically determinate structures – Influence lines for shear force and bending moment in beam section – Calculation of critical stress resultants due to concentrated and distributed moving loads.

UNIT II	INFLUENCE LINES FOR INDETERMINATE STRUCTURES	9

Muller Breslau's principle - Influence line for support reactions, shearing force and bending moments for indeterminate beams - Propped cantilevers, fixed beams and continuous beams.

UNIT III	ARCHES	9

Arches - Eddy's theorem - Types of arches – Analysis of three-hinged, two-hinged and fixed arches - Parabolic and circular arches - Influence lines, rib shortening– Settlement and temperature effects.

UNIT IV	SUSPENSION BRIDGES AND SPACE TRUSSES	9

Analysis of suspension bridges – Unstiffened cables and cables

with three hinged stiffening girders – Influence lines for three hinged stiffening girders - Introduction to analysis of space trusses using method of tension coefficients.		
UNIT V	**PLASTIC ANALYSIS**	**9**
Plastic theory — Statically indeterminate structures — Plastic moment of resistance — Plastic modulus — Shape factor — Load factor — Plastic hinge and mechanism — Collapse load — Static and kinematic methods — Upper and lower bound theorems — Plastic analysis of indeterminate beams and frames.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Analyze the influence lines for statically determinate structures and calculate critical stress resultants.
CO2:	Analyze the influence lines for statically indeterminate beams using Muller Breslau principle.
CO3:	Analyze the three hinged, two hinged and fixed arches.
CO4:	Analyze the suspension bridges with stiffening girders.
CO5:	Analyze the indeterminate beams using plastic analysis.
CO6:	Analyze the indeterminate frames using plastic analysis.
TEXT BOOKS:	
1	Bhavikatti, S.S, “Structural Analysis”, Vol.1 & 2, Vikas Publishing House Pvt.Ltd., New Delhi-4, 2014.
2	Punmia.B.C, Ashok Kumar Jain & Arun Kumar Jain, ‘Theory of structures”, Laxmi Publications, New Delhi, 2004.
REFERENCES:	
1	Gambhir.M.L., “Fundamentals of Structural Mechanics and Analysis”, PHI Learning Pvt. Ltd., 2011.
2	Reddy .C.S, “Basic Structural Analysis”, Tata McGraw Hill Publishing Company, 2005.
3	Negi L.S. and Jangid R.S., “Structural Analysis”, Tata McGraw Hill Publishing. Co. Ltd., 2004.

4	Vazrani.V.N And Ratwani,M.M, “Analysis of Structures”, Vol.II, Khanna Publishers, 2015.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
2	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
3	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
4	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
5	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
6	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1
Overall Correlation	3	3	2	2	-	1	-	1	-	-	-	1	3	-	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE611	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To provide basic knowledge on environment impact assessment
- To create an awareness on the pollutants in the environment
- To familiarize the student with the technology for restoring the environment.
- Applying the technology for producing ECO safe products
- To develop simple climate models and evaluate climate changes using models

UNIT I	INTRODUCTION TO ENVIRONMENT IMPACT ASSESSMENT	9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework

UNIT II	MOVEMENT OF POLLUTANTS IN ENVIRONMENT	9

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, wind mills and hydroelectric power plants.

UNIT III	ECOLOGICAL RESTORATION	9

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste treatment: sources and management (composting, vermiculture

and methane production, landfill. hazardous waste treatment).		
UNIT IV	**ECOLOGICALLY SAFE PRODUCTS AND PROCESSES**	**9**
Biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation		
UNIT V	**CLIMATE CHANGE MODELS**	**9**
Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming –climate change observed to date		
		TOTAL: 45 PERIODS
LIST OF EXPERIMENTS:		**TOTAL: 30 PERIODS**
3. Determination of Bio fuel parameters such as flash point and fire point. 4. Determination of density of biofuels. 5. Determination of BOD/COD in water. 6. Simulating the RCM and GCM model for different geographic conditions. 7. Measurement of Pollutant in environment by Gaussian Plume model.		
		TOTAL: 45+30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the importance of the process of Environmental impact assessment and its types.	
CO2:	Illustrate the chemical processes and pollutant chemistry	
CO3:	Identify the methods to solve environmental problems	
CO4:	Apply the knowledge to develop ecofriendly products.	
CO5:	Construct the various simple climate models for simulation	

CO6:	Apply the climate model simulation to monitor climate change
TEXT BOOKS:	
1	David .E Neelin "Climate Change and Modelling", Cambridge University Press, California 2012.
2	Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
3	Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House
4	N.S. Raman , A.R. Gajbhiye & S.R. Khandeshwar, Environmental Impact Assessment, 2014,IK International Pvt Ltd.
REFERENCES:	
1	Carson (1907-1964). Environment Conservation-book
2	Encyclopaedia of Environmental Issues by Craig W. Allin &Probe.
3	Encyclopaedia of Environmental studies by William Ashworth.
4	Climate Change and Climate Modeling- Kindle Edition.
5	Environmentally- Friendly Product development - Eberhand Abile ,Reiner Anderl,2005

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	1	-	-	-	-	-	2	-	-
2	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
3	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
4	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
5	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
6	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**07-11-2024**		
Approved	**3^{rd} ACM**	**Date**	**30-11-2024**

23CE621	PROJECT WORK PHASE - 1	L	T	P	C
		0	0	4	2

COURSE DESCRIPTION:

This course provides an opportunity for students to apply their engineering knowledge to solve real-world problems through project-based learning. Students, working in groups with maximum of 4 under faculty supervision, undertake a comprehensive project addressing an approved topic. The course focuses on fostering collaboration, research, and practical skills, culminating in a detailed Phase 1 project report and oral presentations. Regular reviews ensure consistent progress and adherence to academic standards.

COURSE OBJECTIVES:

- Encourage students to apply theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork.
- Train students in research methodology, technical documentation, and presentation skills.
- Enhance students' ability to design, analyze, and evaluate solutions systematically.
- Prepare students for real-world engineering challenges and multidisciplinary teamwork.

PROJECT OUTLINE:

Week 1	Orientation and course overview. Formation of project teams and approval of topics by HoD.
Week 2	Initial meeting with supervisors. Define problem statement and objectives.
Week 3	Literature review: Research methodologies and topic-specific studies.
Week 4	Zeroth Review.

Week 5	Refinement of literature review and identification of research gaps.
Week 6	Identification of Base Paper.
Week 7	First Review.
Week 8	Conceptual design discussions and brainstorming solutions.
Week 9	Narrowing done on the exact work.
Week 10	Completion of first stage of the Project.
Week 11	Development of detailed conceptual design and methodology.
Week 12	Incorporation of feedback and refinement of design and methodology.
Week 13	Second Review.
Week 14	Compilation of Phase 1 results, report writing, and presentation preparation.
Week 15	Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work.

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A phase 1 project report is required to be submitted at the end of the semester. Evaluation is based on oral presentation and the phase 1 project report jointly by internal examiners constituted by the Head of the Department.
- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.
- Evaluate the relevance and innovation of practical resources or prototypes developed, focusing on their potential to support sustainability, innovation, and SDG-aligned goals.

- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

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

CO1:	Develop feasible solutions by analyzing complex engineering problems using foundational knowledge, mathematics, and science.
CO2:	Survey literatures to identify gaps, define research questions, and propose designs and methods for solving engineering problems.
CO3:	Make use of modern tools to check the feasibility of the solutions effectively.
CO4:	Evaluate societal and environmental impacts of solutions while incorporating sustainability and ethical practices.
CO5:	Combine in teams to plan, manage, and lead projects within professional and economic constraints.
CO6:	Formulate technical reports, deliver presentations, and engage in lifelong learning to adapt to new technologies.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE622	TECHNICAL TRAINING	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Training' is intended to enable a B.E./B.Tech. Graduate to practice, learn, apply and prepare report about the training undergone. The learner shall be trained in the latest technology in relevant Industry preferably in computer-oriented platform. This course can help the learner to experience training and learn practical skills for the relevant domain. Learner should also be able to present his learning through PPT and report articulating his level of learning about the specific training.

COURSE OBJECTIVES:

- To equip students with practical skills and real-world experience in technical domains, enabling them to effectively apply theoretical knowledge to hands-on applications.
- To develop competencies in working with industry-relevant tools and software technologies.
- To foster teamwork, problem-solving, and technical skills through innovative technologies

COURSE OUTCOMES:

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

CO1:	Identify specific domain from the enrolled branch and to get training preferable in computer-oriented platform.
CO2:	Survey and apprehend the learning modules in the training program and to become expert in the specific domain.

CO3:	Apply theoretical learning in the practical environment and enhance the skillset of learner.
CO4:	Estimate the learning using available data.
CO5:	Defend a presentation about the learning done in the specified skillset.
CO6:	Construct a technical report about the training.

GUIDELINES:

- More than one training program may be given depending on availability and interest of the students. One training coordinator may be appointed for the same.
- Training coordinator shall provide required input to their students regarding the selection of training topic.
- Choosing a Training topic: The topic for a Technical Training should be current and broad based rather than very specific area of interest. It should also be outside the present syllabus. It's advisable to choose a training topic to be computer oriented as the resources for the same may be readily available. Every student of the program should be involved and assessed.
- Head of Department shall approve the selected training topic by the second week of the semester. Training may be assessed based on the ability to apply the skillset in a practical domain.

EVALUATION PATTERN:

Training Coordinator:

50 marks (Training Manual – 40 (Each student shall maintain a Training Manual and the Coordinator shall monitor the progress of the training work on a weekly basis and shall

approve the entries in the Training Manual during the weekly meeting with the student), Attendance – 10,).

Presentation of Application:

Candidate should apply the skillset attained in training. 20 marks to be awarded by the Examiners (Clarity of presentation – 5, Interactions – 10, Quality of the slides – 5).

Report about Application:

30 marks to be awarded by the Examiners (check for technical content, overall quality, templates followed, adequacy of application of the skillset etc.).

Training duration – 30 Hours

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	2	1	-	-	-	-	3	3	-	-
2	3	3	2	1	-	2	1	-	-	-	-	3	3	-	-
3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	1
4	3	3	3	2	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	3	2	2	-	2	-	3	-	3	3	2	2
Overall Correlation	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**2**	**2**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE623	TECHNICAL SEMINAR – 1	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Seminar' is intended to enable a B.E./B. Tech graduate to read, understand,present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned

Seminar topics that covers various aspects linked to the Project area. • A topic/paper relevant to the discipline shall be selected by the student during the semester break. • Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester. • Accurate references from genuine peer reviewed published material to be given in the report and to be verified.
EVALUATION PATTERN
Seminar Coordinator: 40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10). (Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10). **Presentation:** 40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10). **Report:** 20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER – VII

23CE701	COMPREHENSION	L	T	P	C
		2	0	0	2

PURPOSE:

To provide a complete review of the topics covered in the previous semesters, to ensure that a comprehensive understanding of the subjects is achieved. The student will be tested as per the guidelines given by national level examinations like GATE, TANCET etc. It will also help students to face job interviews and competitive examinations.

COURSE OUTCOMES:

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

CO1:	Analyse the phenomena involved in the concerned problem and solve them.
CO2:	Apply principles to new and unique circumstances.
CO3:	Estimate concepts and principles of concerned branch of engineering.
CO4:	Distinguish between facts and opinion in the engineering field.
CO5:	Deduct cause-and-effect relationships of any relationship.
CO6:	Interpret data from charts and graphs and judge the relevance of information.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
3	3	3	3	3	3	-	-	3	-	3	-	3	3	3	3
4	3	2	1	1	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
Overall Correlation	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**3**	**2**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE711	ESTIMATION COSTING AND VALUATION ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To estimate the quantities of work for buildings.
- To understand and apply the concept of rate analysis for Civil Engineering projects.
- To create the tender document for technical projects.
- To understand the contract agreement and drafting of documents.
- To determine the valuation of various civil engineering projects.

UNIT I	QUANTITY ESTIMATION	9

Quantity Estimation for Building; study of various drawing attached with estimates, important terms, units of measurements, abstract, Types of estimates - Approximate, detailed, supplementary and revised, Estimation of building - Short wall and long wall method - Center line method. Estimate of R.C.C structures including Slab, beam, column, footings, with bar bending schedule.

UNIT II	RATE ANALYSIS AND COSTING	9

Standard Data – Observed Data – Schedule of rates – Market rates – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals and Roads – Cost Estimates.

UNIT III	TENDERS	9

Tender and its Process: Invitation to tender, Prequalification, administrative approval & Technical sanction. Bid submission and Evaluation process - Elements of standard Tender document – E-tendering process and the National Building Code (NBC) specifications.

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 of terms used in valuation process, Cost, Estimate, Value and its relationship, Capitalized value. Concept of supply and demand in respect to properties (land, building, and facilities), freehold and lease hold, Sinking fund, depreciation-Methods of estimating depreciation, Outgoings, Process and methods of valuation: Rent fixation, valuation for mortgage, valuation of land.		
		TOTAL: 45 PERIODS

LIST OF EXPERIMENTS:

1. Detailed estimation of a RCC buildings using standard sheets.
2. Detailed estimation of a commercial buildings using standard sheets.
3. Detailed estimation of a Culvert/Bridge using standard sheets.
4. Detailed estimation of a road using standard sheets.
5. Detailed estimation of a septic tank using standard sheets.

TOTAL: 30 PERIODS

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1:	Solve the quantities for buildings works.
CO2:	Evaluate rate of all building works, canals, and roads and cost estimate. Develop the types of specifications and tender practices.
CO3:	Apply knowledge on preparing contracts and legal documents.
CO4:	Solve the valuation for building and all Civil engineering

	works.
CO5:	Evaluate the quantities of works and its specifications.
CO6:	Analyze the Valuation of Properties using different methods, Considering depreciation, rent fixation & Mortage Valuation.
TEXT BOOKS:	
1	Datta B.N., "Estimating and costing", UBSPD Publishing House, New Delhi, 2010.
2	B.S. Patil, "Civil Engineering Contracts and Estimates", Universities Press, 2018.
REFERENCES:	
1	M. Chakraborthi; "Estimation, Costing and Specifications", Laxmi Publications, 2015.
2	Kohli D.D and Kohli R.C, "Estimating and Costing", 12th Edition, S.Chand Publishers, 2014.
3	Vazirani V.N and Chandola S.P, "Estimating and costing", Khanna Publishers, 2015.
4	Rangwala, C. "Estimating, Costing and Valuation", Charotar Publishing House Pvt. Ltd., 2015.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	2	-	-	1	-	-	2	3	-	-
2	3	3	3	3	-	2	-	1	1	1	1	2	3	-	1
3	3	2	1	1	-	2	-	1	1	1	1	2	3	-	1
4	3	2	1	1	1	2	-	1	2	1	1	2	3	1	1
5	3	2	1	1	1	2	-	1	2	1	1	2	3	1	1
6	3	3	2	2	1	2	-	-	1	1	1	2	3	1	-
Overall Correlation	3	3	2	2	1	2	-	1	2	1	1	2	3	1	1

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE721	PROJECT WORK PHASE - 2	L	T	P	C
		0	0	4	3

COURSE DESCRIPTION:

Project Phase 2 is a continuation of Project Phase 1, focusing on implementing the proposed methodology through fabrication, simulation, or experimental validation. Students will refine their designs, validate test problems, and commission setups for final testing. This phase emphasizes hands-on application, calibration, and demonstration of results, culminating in a final presentation and report submission.

COURSE OBJECTIVES:

- Implement the proposed methodology to address engineering problems identified in Phase 1.
- Develop and fabricate prototypes or simulate solutions for the selected project integrating theoretical knowledge with practical application across hardware and software systems.
- Validate solutions through testing ensuring reliability and performance in both physical and virtual environments.
- Enhance problem-solving and critical thinking skills by troubleshooting and optimizing either experiment setups or software code to improve results.
- Prepare a research manuscript or applying for patent grant either for design or research.

PROJECT OUTLINE:

Week 1	Review of Phase 1 outcomes and refinement of proposed methodology.
Week 2	Material procurement/ software setup for simulation, and initiation of fabrication/simulation work.

<table>
<tr><td>Week 3</td><td>Intermediate fabrication/simulation work and initial testing or calibration, troubleshooting challenges.</td></tr>
<tr><td>Week 4</td><td>Second Review.</td></tr>
<tr><td>Week 5</td><td>Validation of test problem or refinement of prototype/simulation.</td></tr>
<tr><td>Week 6</td><td>Optimisation of the test setup or solution trials, Data curation / uncertainty analysis.</td></tr>
<tr><td>Week 7</td><td>Final testing of setup or simulation outcomes, Validation of Data.</td></tr>
<tr><td>Week 8</td><td>Third Review</td></tr>
<tr><td>Week 9</td><td>Demonstration of the solution with high level of data accuracy and precision.</td></tr>
<tr><td>Week 10</td><td>Compilation of Phase 2 results, report writing, and presentation preparation.</td></tr>
<tr><td>Week 11</td><td>Preparing or publishing of research article/ Filing or Grant of Patent</td></tr>
<tr><td>Week 12</td><td>Final Viva Voce Presentations.</td></tr>
<tr><td colspan="2">Individual meetings will be set up on a need's basis in conjunction with developing work.</td></tr>
<tr><td colspan="2">EVALUATION:</td></tr>
<tr><td colspan="2">The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.</td></tr>
</table>

- Publication of Research article in indexed journal or Patent award is necessary at the end of completion of the project.

COURSE OUTCOMES:

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

CO1:	Apply appropriate methodologies to implement solutions for complex engineering problems identified in phase -1 using hardware / software or both systems.
CO2:	Develop existing functional prototypes or simulations models by integrating theoretical and practical knowledge.
CO3:	Evaluate solutions ensuring compliance with design specifications.
CO4:	Appraise the performance of solutions by refining designs or improving algorithms for enhanced outcomes.
CO5:	Collaborate effectively with team members to plan, manage, and execute engineering projects adhering to ethical principles and professional standards.
CO6:	Prepare technical reports, impactful presentations that communicate solutions effectively.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23CE722	TECHNICAL SEMINAR – 2	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Seminar 2' is intended to be continuation of Technical Seminar 1. It enables a B.E./B. Tech graduate to read, understand, present and prepare report about higher level academic document. The selected topic should be outside the given syllabus. The learner shall search in the literature / current affairs including mass media, print media, peer reviewed journals, conference, books, project reports etc., and identify an appropriate topic/paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a higher-level presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study.
- To understand an academic document from the literature and to give a presentation about it.
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very

specific research work, beyond the syllabus. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10). (Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

COURSE OUTCOMES:

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

CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

Recommended by Board of Studies	**08-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

SEMESTER -VIII

23CE821	CAPSTONE PROJECT	L	T	P	C
		0	0	20	10

COURSE DESCRIPTION:

Prerequisites:

i) Team segregation.
ii) Identification of Project Guide.
iii) Identification of Area of Interest.
iv) Literature Review on the chosen area of interest.

Zeroth Review needs to be completed in the previous semester by the project coordinator

The *Capstone Project* ***(CP)*** provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the engineering field. Capstone projects will be investigative, practice-centered. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students

The aim of the course is to facilitate the development of your *Capstone Projects.* Students are encouraged to apply and expend knowledge gained on teaching and learning throughout the Bachelor of Engineering Education program as part of this process

COURSE OBJECTIVES:

The Capstone Project should demonstrate the depth and extent of knowledge of students

During this course, students will

- Investigate and evaluate prominent literature connected to your CP.
- Present a clearly articulated investigative framework, while situating projects within established academic

practices and/ or ideas. • Develop and create practical resources (either computational or experimental) for the concerned area of interest in engineering field. • Offer inquiry-based argumentation for development in the concerned area within engineering field. • Summarize the findings in the form of report, documentation and presentation

PROJECT OUTLINE:

Week 1	Identification problem.
Week 2	Literature review.
Week 3	Preliminary work.
Week 4	First review.
Week 5	Completion of first stage of the Project methodology.
Week 6	Development.
Week 7	Testing & Validation.
Week 8	Second review.
Week 9	Repeatability.
Week 10	Report correction and Documentation
Week 11	Third review-Submission of paper for conference/journal
Week 12	Thesis Correction and Submission

Individual meetings will be set up on a need's basis in conjunction with developing work

COURSE OUTCOMES:

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

CO1:	Take part in challenging practical problems and find solutions by formulating proper methodology.
CO2:	Plan research methodology to tackle a specific problem.
CO3:	Construct extensive study on particular research projects.
CO4:	Develop experimental and computational studies on innovative research projects.
CO5:	Estimate incremental study on existing research projects.

CO6:	Take part in real life engineering challenges and propose appropriate solutions.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	2	3	3	2	3	2	3	2	3	2	3	3	2	3
3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Recommended by Board of Studies	**07-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

VERTICAL -1 – STRUCTURES

23CE031	REPAIR & REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire the knowledge on quality of concrete, durability aspects, causes of deterioration,assessment of distressed structures, repairing of structures, Restoration of Heritage structures and demolition procedures.

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	SERVICEABILITY 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	REPAIR MATERIALS	9

Materials used to repair heritage structures – Limecrete - High performance concrete – Ultra High performance concrete – Vacuum Concrete – Shotcrete – 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.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Demonstrate the importance of inspection and maintenance.
CO2:	Illustrate the impacts of cracks, corrosion and climate on structures.
CO3:	Illustrate various repair materials.
CO4:	Demonstrate the testing techniques and various protection measures.
CO5:	Infer the Repair of structures distressed due to natural or manmade disasters.
CO6:	Interpret use of techniques in Restoration of Heritage structures.
TEXT BOOKS:	
1	Shetty.M.S. Jain A K., "Concrete Technology", - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2	B.Vidivelli, "Rehabilitation of Concrete Structures", Standard Publishes Distribution.1st edition 2009.
REFERENCES:	
1	"Hand book on Seismic Retrofit of Buildings", CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2	"Hand Book on Repair and Rehabilitation of RCC Buildings", – Director General works CPWD, Govt of India , New Delhi – 2002.
3	P.C.Varghese, "Maintenance Repair and Rehabilitation & Minor works of building", Prentice Hall India Pvt Ltd 2014.

4	Dodge Woodson, Concrete Structures, Protection, "Repair and Rehabilitation, Butterworth-Heinemann", Elsevier, New Delhi 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
2	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
3	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
4	2	1	-	-	1	1	1	1	1	2	1	2	2	1	1
5	2	1	-	-	2	1	1	1	1	2	1	2	2	2	1
6	2	1	-	-	2	1	1	1	1	2	1	2	2	2	1
Overall Correlation	2	1	-	-	2	1	1	1	1	2	1	2	2	2	1

23CE032	DYNAMICS AND EARTHQUAKE RESISTANT STRUCTURES	L	T	P	C
		3	0	0	3

COURSE 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 – Seismo tectonics – 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 completion of the course, the students will be able to:	
CO1:	Develop the equations of motion for SDOF and MDOF system and to evaluate the natural frequencies and mode shapes.
CO2:	Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation.
CO3:	Explain the effect of earthquake on soil structure interaction.
CO4:	Explain the behavior of various types of structures under earthquake.
CO5:	Model the earthquake forces on structures.
CO6:	Develop design technique for earthquake resistant building structures.
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.
REFERENCES:	
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.

4	Moorthy.C.V.R., "Earthquake Tips", NICEE, IIT Kanpur,2002.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	1	1	1	1	2	3	1	1
2	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
3	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
4	2	1	-	-	1	1	1	2	1	2	1	2	2	1	2
5	3	2	1	1	2	1	1	2	1	2	1	2	3	2	2
6	3	2	1	1	2	1	1	2	1	2	1	2	3	2	2
Overall Correlation	3	2	1	1	2	1	1	2	1	2	1	2	3	2	2

223CE033	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

COURSE 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, Magnel, 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 completion of the course, the students will be able to:	
CO1:	Solve a Prestressed concrete beam accounting for losses.	
CO2:	Analyze the flexural and shear capacity of Prestressed concrete beams.	
CO3:	Analyze the deflection in beams.	
CO4:	Identify the anchorage zone reinforcement for post-tensioned members.	
CO5:	Analyze the composite members and continuous beams.	
CO6:	Analyze the reinforcement requirement for water tanks, pipes, poles and sleepers.	
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	

REFERENCES:	
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

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	2	1	1	1	2	3	1	2
2	3	3	2	2	1	1	1	2	1	1	1	2	3	1	2
3	3	2	1	1	1	1	1	2	1	1	1	2	3	1	2
4	3	3	2	2	1	1	1	2	1	1	1	2	3	1	2
5	3	3	2	2	1	1	1	2	1	1	1	2	3	1	2
6	3	3	2	2	1	1	1	2	1	1	1	2	3	1	2
Overall Correlation	3	3	2	2	1	1	1	2	1	1	1	2	3	1	2

23CE034	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concepts of prefabrication.
- To acquire the knowledge of prefabrication components and systems.
- To understand the design principles in prefabrication.
- To perceive the types of joints and connections in structural members.
- To impart knowledge about the structural stability.

UNIT I	INTRODUCTION	9

Need for prefabrication -Advantages and limitations – Principles of prefabrication – Modular coordination – Standarization– Loads and load combinations– Materials – Production – Transportation – Erection.

UNIT II	PREFABRICATED COMPONENTS AND SYSTEMS	9

Behaviour and types of structural components– roof and floor slabs – Walls panels - Shear walls - Beams - Columns – skeletal system - portal frame system - Large panel systems - Block system.

UNIT III	DESIGN PRINCIPLES	9

Design philosophy - Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems - Design for stripping, stacking, transportation and erection of elements.

UNIT IV	JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS	9

Types of Joints – Based on action of forces - compression joints - Shear joints - Tension joints - based on function - Construction joints, contraction joints, expansion joints. Design of expansion joints - Dimensions and detailing - Types of sealants - Types of

structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.		
UNIT V	**DESIGN FOR ABNORMAL LOADS**	**9**
Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse - case study.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline the concepts about principles of prefabrication, production, transportation, erection.
CO2:	Utilize suitable panel systems, slabs, beams, shear walls and columns in precast construction.
CO3:	Interpret shear walls and columns used in precast construction.
CO4:	Analyze the efficient use of materials in designing cross section, joint flexibility.
CO5:	Develop knowledge about joints and connection in precast construction.
CO6:	Apply knowledge on structural stability avoiding progressive collapse
TEXT BOOKS:	
1	Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA, 1991.
2	Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties And Usage", CRC Press, 2019.
REFERENCES:	
1	Alfred Steinle, Hubert Bachmann, Mathias Tillmann, Philip Thrift , "Precast Concrete Structures", Ernst & Sohn, Berlin, 2019.
2	Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
3	"Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.

4	"Precast concrete connection details", Structural Design manual, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	2	1	2	1	2	2	1	2
2	3	2	1	1	1	1	1	2	1	2	1	2	3	1	2
3	2	1	-	-	1	1	1	1	1	2	1	2	2	1	1
4	3	3	2	2	2	1	1	1	2	2	1	2	3	2	1
5	3	2	1	1	1	1	1	1	1	2	1	2	3	1	1
6	3	2	1	1	1	1	1	1	1	2	1	2	3	1	1
Overall Correlation	3	2	1	1	2	1	1	2	2	2	1	2	3	2	2

23CE035	STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
To develop an understanding of the effect composite action and assess governing limit statesfor composite elements.

UNIT I	**INTRODUCTION TO COMPOSITE ACTION**	**9**
Introduction to steel - concrete composite construction – codes – composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections.		
UNIT II	**DESIGN OF COMPOSITE BEAM**	**9**
Introduce composite beams, including shear studs – Determine the location of a beam's neutral axis/axes depending on the level of composite action. Calculate shear stud strength and understand strength modifiers - deflection of composite beams.		
UNIT III	**DESIGN OF COMPOSITE COLUMN**	**9**
Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni- axial and bi-axially loaded columns.		
UNIT IV	**DESIGN OF COMPOSITE SLAB**	**9**
Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span.		
UNIT V	**CASE STUDIES**	**9**
Case studies on steel concrete composite construction in buildings - seismic behaviour of composite structures.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Identify the effect of composite action on structural component.
CO2:	Analyze the neutral axis depth and shear strength for composite beam.

CO3:	Infer the governing limit states for composite column.
CO4:	Infer the governing limit states for composite slab.
CO5:	Examine the case studies related to steel concrete composite constructions of buildings.
CO6:	Examine the case studies related to seismic behaviour of composite structures.
TEXT BOOKS:	
1	Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018.
2	Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Revised Edition, Pergamon press, Oxford, 2000.
REFERENCES:	
1	Owens.G.W and Knowles.P, "Steel Designers Manual", Seventh Edition, Steel Concrete Institute" (UK), Oxford Blackwell Scientific Publications, 2011.
2	Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.
3	Narayanan R, "Composite steel structures – Advances, design and construction", Elsevier, Applied science, UK, 1987.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	2	2	2	1	2	3	1	2
2	3	3	2	2	2	1	1	2	2	2	1	2	3	2	2
3	2	1	-	-	2	1	1	2	2	2	1	2	2	2	2
4	2	1	-	-	2	1	1	2	2	2	1	2	2	2	2
5	3	3	2	2	1	1	1	2	2	2	1	2	3	1	2
6	3	3	2	2	1	1	1	2	2	2	1	2	3	1	2
Overall Correlation	3	3	2	2	2	1	1	2	2	2	1	2	3	2	2

23CE036	SMART MATERIALS AND SMART STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To know the latest developments in smart materials and their use in structures.

UNIT I	INTRODUCTION	9

Introduction to Smart Materials and Structures – Instrumented structures functions and response – Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

UNIT II	MEASURING TECHNIQUES	9

Strain Measuring Techniques using Electrical strain gauges, Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT III	SENSORS	9

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors – Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV	ACTUATORS	9

Actuator Techniques – Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electro orheological Fluids– Electro magnetic actuation – Role of actuators and Actuator Materials.

UNIT V	SIGNAL PROCESSING AND CONTROL SYSTEMS	9

Data Acquisition and Processing – Signal Processing and Control

for Smart Structures – Sensors as Geometrical Processors – Signal Processing – Control System – Linear and Non- Linear.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the role of instrumented structures in smart systems and describe how they function and respond to stimuli.
CO2:	Explain the working principles of electrical strain gauges and how they measure strain in materials using resistance, capacitance, and inductance.
CO3:	Explain the working principles of piezoelectric strain measurement, and its applications in various sensing systems.
CO4:	Illustrate the operation and contribution of absorptive chemical sensors and spectroscopes to distributed measurement for real-time structural monitoring.
CO5:	Summarize the role and significance of actuators and actuator materials in engineering systems.
CO6:	Demonstrate the role of signal processing in smart structures, focusing on how data from sensors is filtered, amplified, and interpreted to monitor and control system behavior.
TEXT BOOKS:	
1	Brain Culshaw, "Smart Structure and Materials," Artech House – Borton. London-1996 (Reprint 2008).
2	P. Gauenzi, "Smart Structures", Wiley, India, 2009.
REFERENCES:	
1	A. V. Srinivasan, "Smart Structures: Analysis and Design", Cambridge University Press, Cambridge, New York, 2001.
2	L. S. Srinath, "Experimental Stress Analysis" Tata McGraw-Hill, 1998 (Reprint 2015).
3	J. W. Dally & W. F. Riley, "Experimental Stress Analysis" Tata McGraw-Hill, 1998 (Reprint 2010).

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
2	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
3	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
4	2	1	-	-	2	1	1	1	1	1	2	1	2	2	1
5	2	1	-	-	2	1	1	1	1	1	1	2	2	2	1
6	2	1	-	-	2	2	1	1	1	1	1	2	2	2	1
Overall Correlation	2	1	-	-	2	2	1	1	1	1	1	2	2	2	1

VERTICAL -2 – GEOTECHNICAL

23CE037	GEO-ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The student acquires knowledge on the Geotechnical engineering problems associated with soil contamination, and safe disposal of waste.
- The student can be able to remediate the contaminated soils by different techniques thereby protecting the environment.

UNIT I	GENERATION OF WASTES AND CONSEQUENCES OF SOIL POLLUTION	9

Introduction to Geo-environmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution interaction clay minerals – Failures of foundation due to waste movement.

UNIT II	SITE SELECTION AND SAFE DISPOSAL OF WASTE	9

Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid or flexible liners.

UNIT III	TRANSPORT OF CONTAMINANTS	9

Contaminant transport in sub surface – Advection, Diffusion, Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Hydrological consideration in land fill design – Ground water pollution.

UNIT IV	WASTE STABILIZATION	9
Stabilization – Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement – case studies.		
UNIT V	**REMEDIATION OF CONTAMINATED SOILS**	**9**
Exsitu and Insitu remediation-Solidification, bio-remediation, incineration, soil washing, phytoremediation, soil heating, vetrification, bio-venting.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize waste generation and failures of foundation due to waste movement.
CO2:	Identify the site for waste disposal and current practice of waste disposal.
CO3:	Identify suitable method to improve the ground characteristics without contamination using suitable transportation.
CO4:	Summarize the mechanism of waste stabilization.
CO5:	Summarize the remedial measures for contaminated soils.
CO6:	Apply various remediation techniques to avoid soil contamination.
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 & Hall, London 1993.
REFERENCES:	
1	Westlake, K, “Landfill Waste pollution and Control”, Albion Publishing Ltd., England, 1995.

2	Wentz, C.A., “Hazardous Waste Management”, McGraw Hill, Singapore, 1989.
3	Proceedings of the International symposium on “Environmental Geotechnology” (Vol.I and II). Environmental Publishing Company, 1986 and 1989.
4	Ott, W.R., “Environmental indices, Theory and Practice”, Ann Arbor, 1978.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	1	-	1	2	1	2	1	1
2	3	2	1	1	1	2	2	1	-	2	1	1	3	1	1
3	3	2	1	1	1	1	2	1	-	1	1	1	3	1	1
4	2	1	-	-	1	2	2	1	1	1	1	1	2	1	1
5	2	1	-	-	1	2	2	1	1	1	1	1	2	1	1
6	3	2	1	1	1	2	2	1	1	2	2	1	3	1	1
Overall Correlation	3	2	1	1	1	2	2	1	1	2	1	1	3	1	1

23CE038	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- The students will be introduced to various problems associated with soil deposits and methods to evaluate them.
- Understand the techniques to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

UNIT I	HYDRAULIC MODIFICATION	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 MODIFICATION	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	9

Preloading with sand drains, fabric drains, wick drains – Theories of sand drain - Stone column with and without encased, limestone – 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 INCLUSION	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 completion of the course, the students will be able to:
CO1:	Identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications.
CO2:	Explain the mechanical modifications on ground characteristics using various methods and design the system.
CO3:	Explain the physical modifications on ground characteristics using various methods and design the system.
CO4:	Choose suitable method to improve the characteristics of soils with various reinforcement techniques and design.
CO5:	Explain the grouting technique for improving soil characteristics.
CO6:	Explain the chemical stabilization for improving the Engineering Properties of soil.
TEXT BOOKS:	
1	Purushothama Raj. P, "Ground Improvement Techniques", Firewall Media, 2005.
2	Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering", Mc Graw Hill, 1994.
REFERENCES:	
1	Moseley, M.P., "Ground Improvement Blockie Academic and Professional", Chapman and Hall, Glasgow, 2004.
2	Das, B.M., "Principles of Foundation Engineering" (seventh edition), Cengage learning, 2010.

3	Koerner, R.M., “Designing with Geosynthetics” (Fourth Edition), Prentice Hall, Jersey, 2012.
4	IS Code 9759 : 1981 (Reaffirmed 1998) “Guidelines for Dewatering During Construction”, Bureau of Indian Standards, New Delhi.
5	IS Code 15284 (Part 1): 2003 “Design and Construction for Ground Improvement – Guidelines” (Stone Column), Bureau of Indian Standards, New Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	2	2	-	-	1	1	1	3	1	-
2	2	1	-	-	-	2	2	1	2	1	1	1	2	-	1
3	2	1	-	-	-	2	2	1	2	1	1	1	2	-	1
4	3	2	1	1	1	2	2	1	2	1	1	1	3	1	1
5	2	1	-	-	1	2	2	1	2	1	1	1	2	1	1
6	2	1	-	-	1	2	2	1	1	1	1	1	2	1	1
Overall Correlation	3	2	1	1	1	2	2	1	2	1	1	1	3	1	1

23CE039	PILE FOUNDATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The design of piles, pile groups, and caissons with respect to vertical and lateral loads for various field conditions.

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.

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 completion of the course, the students will be able to:
CO1:	Explain the importance of pile foundation and the various functions and responsibilities of the geotechnical engineer and contractor.
CO2:	Calculate the axial load carrying capacity of pile and pile groups.
CO3:	Explain piles under lateral loads and uplift loads.
CO4:	Calculate the necessary reinforcement for the piles.
CO5:	Calculate the necessary reinforcement for the pile caps.
CO6:	Analyze the Stability and design Concepts of Caisson.
TEXT BOOKS:	
1	Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2015.
2	Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International (P) Ltd, New Delhi, 2006.
REFERENCES:	
1	Arora, K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.
2	Varghese, P.C., "Foundation Engineering", Prentice Hall of India Private Limited, New Delhi, 2005.
3	Das, B.M., "Principles of Foundation Engineering, Design and Construction", Fourth Edition, PWS Publishing, 1999.

4	Varghese P.C.," Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi, 2009.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	2	2	1	1	2	1	1
2	3	2	1	1	1	-	1	1	1	1	1	1	3	1	1
3	2	1	-	-	1	1	1	1	1	1	-	1	2	1	1
4	3	2	1	1	1	-	1	1	1	1	1	1	3	1	1
5	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1
6	2	1	-	-	1	1	1	1	2	2	1	1	2	1	1
Overall Correlation	3	2	1	1	1	1	1	1	2	2	1	1	3	1	1

23CE040	TUNNELING ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To visualize and critically analyze the behavior of underground structures regarding various supporting systems under different loading conditions due to induced earth pressure on the underground structures.
- To understand the use of the equipment in underground excavations.

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 tunnelling - 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	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Infer the need for the utilization of underground space for various applications.
CO2:	Summarize various methods of excavations for tunneling.
CO3:	Determine the geometrical parameters of tunnels.
CO4:	Explain the advanced drilling techniques for construction of tunnels.
CO5:	Classify the various tunnel supporting system.
CO6:	Explain the ground freezing techniques and methods of ventilation.
TEXT BOOKS:	
1	Murthy, V.N.S., “Soil Mechanics and Foundation Engineering”, CBS Publishers and Distributers Ltd., New Delhi, 2015.
2	Gopal Ranjan and Rao A.S.R. “Basic and Applied soil mechanics”, New Age International (P) Ltd, New Delhi, 2006.
REFERENCES:	
1	R.K.Goel, Bhavani Singh, Jian Zhao, “Underground infrastructure planning design construction”, Butterworth Heinemunn Publishers.
2	John Wiley and Son, “Practical tunnel construction”, Hemphill G.B 2012.
3	David chapran, Nicole Metse and Alfred Stark, “Introduction to tunnel construction”, Spor press.
4	Sahashi K Gulhati, Manoj Datta, “Geotechnical

	Engineering", Tata McGraw-Hill Education, 2005.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	-	1	1	-	-	1	2	1	1
2	2	1	-	-	1	-	-	-	-	-	-	1	2	1	-
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	-
4	2	1	-	-	1	-	-	-	-	-	-	1	2	1	-
5	2	1	-	-	-	1	1	-	-	1	1	1	2	-	-
6	2	1	-	-	1	2	1	1	1	1	1	1	2	1	1
Overall Correlation	3	2	1	1	1	1	1	1	1	1	1	1	3	1	1

23CE041	EARTH RETAINING STRUCTURES	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
At the end of this course, students are expected to analyze and design rigid, flexible earth-retaining structures, slurry-supported trenches, and deep cuts.					
UNIT I	**EARTH PRESSURE THEORIES**				**9**
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	**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 - Slurry Supported Trenches-Basic principles – Slurry characteristics – Specifications – Diaphragm walls – stability Analysis.					

UNIT V	STABILITY OF SLOPES	9
Stability of infinite and finite slopes, Limit Equilibrium method, Wedge analysis, Method of Slices, Bishop's method, Janbu's method etc. Special aspects of slope analysis, stability charts. Role of geosynthetics in stabilization of slopes.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Calculate the earth pressure acting on retaining structures.
CO2:	Analyze the stability of retaining structures.
CO3:	Analyze and design of sheet pile walls.
CO4:	Analyze and design of braced excavations, slurry-supported trenches.
CO5:	Analyze the stability of infinite and finite slopes.
CO6:	Apply the knowledge of engineering for the stabilization of soils by geosynthetics.

TEXT BOOKS:	
1	Clayton, C.R.I., Militisky, J. and Woods, R.I., "Earth pressure and Earth-Retaining structures", Second Edition, Survey University Press, 1993.
2	Das, B.M., "Principles of Geotechnical Engineering", Fourth Edition, The PWS series in Civil Engineering, 1998.

REFERENCES:	
1	Koerner, R.M, "Designing with Geosynthetics", Third Edition, Prentice Hall, 1997.
2	Day, R.W., "Geotechnical and Foundation Engineering: Design and Construction", McGraw Hill, 1999.
3	Mandal, J.N., "Reinforced Soil and Geotextiles", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.
4	McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", Sixth Edition, Prentice Hall, 2002.

COs	Pos												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	2	2	1	1	1	1	2	3	1	1
2	3	3	2	2	1	2	2	1	1	1	1	2	3	1	1
3	3	3	2	2	1	2	2	1	1	1	-	2	3	1	1
4	3	3	2	2	1	2	2	1	1	1	1	2	3	1	1
5	3	3	2	2	1	2	2	1	1	1	1	2	3	1	1
6	3	2	1	1	2	2	2	1	1	1	1	2	3	2	1
Overall Correlation	3	3	2	2	1	2	2	1	1	1	1	2	3	1	1

23CE042	SOIL DYNAMICS AND MACHINE FOUNDATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To design different types of machine foundations based on the dynamic properties of soils and to get exposure on vibration isolation techniques.

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 factors – 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 - Empirical 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

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the theories of vibration to analyze the behaviour of machine foundation.
CO2:	Determine the dynamic properties of soil using laboratory and field tests.
CO3:	Summarize the types of machine foundations and its design principles.
CO4:	Evaluate design parameters and select appropriate foundations for different types of machines.
CO5:	Apply empherical methods and codal recommendations for machine foundation design.
CO6:	Apply vibration isolation techniques for machine foundations
TEXT BOOKS:	
1	S Prakash and V K Puri, "Foundations for Machines: Analysis and Design", Wiley, 1988.
2	S Saran, "Soil Dynamics and Machine Foundations", Galgotia Publications Pvt Ltd, 1999.
REFERENCES:	
1	B M Das and G V Ramana, "Principles of Soil Dynamics", Cengage Engineering, 2014.
2	B B Prasad, "Fundamentals of Soil Dynamics and Earthquake Engineering", PHI, 2013.

3	Bhatia K.G., "Foundations for Industrial Machines, Handbook for Practicing Engineers", CRC Press Inc., 2009.
4	McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", Sixth Edition, Prentice Hall, 2002.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	1	2	2	1	2	2	2	3	2	2
2	3	2	1	1	2	2	2	2	1	2	1	2	3	2	2
3	2	1	-	-	2	2	2	2	1	1	1	2	2	2	2
4	3	2	1	1	2	2	2	2	1	1	1	2	3	2	2
5	3	2	1	1	2	1	2	2	1	1	1	2	3	2	2
6	3	2	1	1	2	1	2	2	2	2	2	2	3	2	3
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	3

VERTICAL -3 – TRANSPORTATION AND INFRASTRUCTURES

<table>
<tr><td rowspan="2">23CE043</td><td rowspan="2">INTELLIGENT TRANSPORTATION SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">• To learn the fundamentals of ITS.
• To study the ITS functional areas
• To have an overview of ITS implementation in developing countries</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO ITS</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT II</td><td colspan="4">DATA COLLECTION THROUGH ITS</td><td>9</td></tr>
<tr><td colspan="6">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).</td></tr>
<tr><td>UNIT III</td><td colspan="4">ITS IN TRAFFIC MANAGEMENT</td><td>9</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">ITS IN TRANSPORTATION PLANNING</td><td>9</td></tr>
<tr><td colspan="6">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.;</td></tr>
</table>

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

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the fundamentals of ITS and its benefits.
CO2:	Understand the Principles and Applications of Various Sensors used in Traffic Data.
CO3:	Apply Various Latest trends in Traffic Data Collection and Analysis.
CO4:	Apply the knowledge of ITS in-Traffic Management.
CO5:	Apply ITS in-Transportation Planning.
CO6:	Summarize the application of ITS in Logistics.
TEXT BOOKS:	
1	R. Srinivasa Kumar, "Intelligent Transportation Systems", Universities Press Pvt., Ltd, Telangana, 2022.
2	Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001
REFERENCES:	
1	Henry F.Korth, and Abraham Siberschatz, "Data Base System Concepts", McGraw Hill, 1992.
2	Sitausu S. Mittra, "Decision Support Systems–Tools and Techniques", John Wiley, New York, 1986.
3	Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems–Theory and Application", Springer Verlog, New York, 1987
4	Kan Paul Chen, John Miles, "Recommendations for World Road Association (PIARC)", ITS Hand Book 2000:

Cos	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	2	2	1	2	1	2	2	2	3	1
2	2	1	-	-	3	2	2	2	2	2	2	2	2	3	2
3	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2
4	3	2	1	1	3	2	1	1	2	2	1	1	3	3	1
5	3	2	1	1	3	2	1	1	2	1	2	2	3	3	1
6	2	1	-	-	3	2	1	2	2	2	2	2	2	3	2
Overall Correlation	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2

23CE044	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.

UNIT I	INTRODUCTION	7

Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Sub-urbanisation, 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	10

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, Neighborhoods, Theories of Ekistics, Bid-rent Theory by William Alonso, Green Belt Concept.

UNIT III	DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION	10

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	10

Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and

Institutional constraints – Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.		
UNIT V	**URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS**	**8**
Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain Key Terms, Policies related Urban Planning & Development.
CO2:	Outline the different types of theories of urban planning and city development.
CO3:	Explain the different types of plans, their strategies and their preparation process.
CO4:	Summarize the planning standards.
CO5:	Solve for the constraints and the financial mechanism.
CO6:	Summarize on various town and country planning acts and their functions.
TEXT BOOKS:	
1	Goel, S.L, "Urban Development and Management", Deep and Deep publications, New Delhi 2002.
2	Singh V.B, "Revitalised Urban Administration in India", Kalpaz publication, Delhi, 2001.
REFERENCES:	
1	"Tamil Nadu Town and Country Planning Act 1971, and Rules" made there under, Government of Tamil Nadu, Chennai.

2	Thooyavan, K.R., "Human Settlements – A Planning Guide to Beginners", M.A Publications, Chennai, 2005.
3	"Chennai City Municipal Corporation Act", 1919 and Tamil Nadu District Municipalities Act, 1920.
4	"The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act", 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	1	2	1	2	1	2	1	1
2	2	1	-	-	1	2	2	2	2	1	2	2	2	1	2
3	2	1	-	-	1	2	2	1	2	2	1	1	2	1	1
4	2	1	-	-	2	1	2	2	2	1	2	2	2	2	2
5	3	2	1	1	2	1	2	2	2	1	2	2	3	2	2
6	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

23CE045	TRANSPORTATION PLANNING PROCESS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge in the rudiments and stages in Transportation Planning Process.

UNIT I	TRANSPORTATION PLANNING PROCESS	9

Importance of transportation planning, Integration of Land Use and Transport; Systems Approach to Transport Planning; Four Steps in the Transport Planning Process; Travel Demand Modelling Approach; Traffic Analyses Zones – Internal and external; Various Transportation Surveys for the collection of data – Methodology, analyses of data and presentation of results.

UNIT II	TRIP GENERATION STAGE	9

Definition and importance; Trip Production and Attraction, Types of trips; Factors governing trip generation: population related data, land and building use, socio-economic, Trip generation models: Types, Assumptions made, Multiple Linear Regression, category analysis- merits and de-merits of the model, verification, calibration and validation of the model.

UNIT III	TRIP DISTRIBUTION STAGE	9

Definition and objective; Data collection, analyses and presentation of trip matrix table, Desire Line Diagram, Development of Gravity, growth factor methods for Trip Distribution, Calibration of gravity model and its validation.

UNIT IV	MODAL SPLIT STAGE	9

Factors influencing mode choice - Household characteristics; Zonal Characteristics; Network characteristics - Modal split: pre distribution or post distribution - Mode wise trip matrix and modal split analyses - Overview of Probit and Logit model.

UNIT V	TRAFFIC ASSIGNMENT STAGE	9

Meaning and objective; General principles; Assignment

Techniques - all- or - nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Mode-wise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the principles of the transportation planning process and methods of data collection.
CO2:	Explain the importance of trip generation in transportation planning and Urban Development.
CO3:	Explain the Principles Behind different trip generation Models.
CO4:	Summarize the trip distribution stage.
CO5:	Explain characteristics associated with the model split stage.
CO6:	Summarize the general principles and assignment techniques related to traffic assignment.
TEXT BOOKS:	
1	Kadiyali. L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2019.
2	C.S. Papacostas and P.D. Prevedouros, "Transportation Engineering and Planning", Prentice Hall of India Pvt. Ltd., 2009.
REFERENCES:	
1	J D Ortuzar and L G Willumnsen, "Modeling Transport", John Wiley and Sons, New York, 2011.
2	John W. Dickey, "Metropolitan Transportation Planning", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.
3	"Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority", 2007.
4	James H.Banks, "Introduction to Transportation Engineering", Tata McGraw Hill Education Pvt Ltd, 2010.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	2	2	2	1	2	1	2	2	2
2	2	1	-	-	2	1	1	1	1	1	2	1	2	2	1
3	2	1	-	-	2	1	1	1	1	1	2	1	2	2	1
4	2	1	-	-	2	1	1	2	2	1	2	1	2	2	2
5	2	1	-	-	2	2	1	2	2	2	2	1	2	2	2
6	2	1	-	-	2	2	1	2	1	1	2	1	2	2	2
Overall Correlation	2	1	-	-	2	2	2	2	2	2	2	1	2	2	2

23CE046	SMART CITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To help the leaners to understand the concepts of smart city and to introduce the students about application of technologies in smart cities.

UNIT I	INTRODUCTION	6

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	12

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	10

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	8

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

COURSE OUTCOMES:

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

CO1:	Illustrate the basics of Urbanisation and the role of smart cities.
CO2:	Apply smart physical infrastructure techniques in smart cities.
CO3:	Illustrate about Smart Public Transport.
CO4:	Summarize the role of smart planning for sustainable development.
CO5:	Explain the technologies in Smart City planning.
CO6:	Outline the case studies of smart city projects.

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.

REFERENCES:

1	Binti Singh, Manoj Parmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory", Routledge India,2019
2	N. Mani, "Smart Cities and Urban Development in India", New Century Publications, 2016.
3	Germaine R. Halegoua, "Smart Cities", MIT Press, 2020.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	2	2	1	1	2	2	1	2	3	1
2	3	2	1	1	2	2	2	2	2	1	2	1	3	2	2
3	2	1	-	-	1	2	2	2	2	1	2	1	2	1	2
4	2	1	-	-	1	1	2	2	2	2	2	2	2	1	2
5	2	1	-	-	3	2	2	2	2	1	2	2	2	3	2
6	2	1	-	-	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2

<table>
<tr><td rowspan="2">23CE047</td><td rowspan="2">PAVEMENT ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT I</td><td colspan="4">PAVEMENT MATERIALS AND SUBGRADE ANALYSIS</td><td>8</td></tr>
<tr><td colspan="6">Introduction – Pavement as layered structure – Pavement types - Rigid and flexible-Subgrade analysis - Stress and deflections in pavements - Pavement Materials and Testing - Modified Binders.</td></tr>
<tr><td>UNIT II</td><td colspan="4">DESIGN OF FLEXIBLE PAVEMENTS</td><td>10</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td>UNIT III</td><td colspan="4">DESIGN OF RIGID PAVEMENTS</td><td>9</td></tr>
<tr><td colspan="6">Cement concrete pavements Factors influencing CC pavements – Modified Wester gaard approach - Design procedure as per IRC guidelines – Concrete roads and their scope in India.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE</td><td>10</td></tr>
<tr><td colspan="6">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).</td></tr>
</table>

UNIT V	STABILIZATION OF PAVEMENTS	8
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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Classify the types of rigid and flexible pavements.
CO2:	Solve for the geometrical parameters of flexible pavements.
CO3:	Solve for the geometrical parameters of rigid pavements.
CO4:	Identify the causes of distress in rigid and flexible pavements.
CO5:	Explain Pavement maintenance and Serviceability in pavements
CO6:	Illustrate stabilization of pavements, testing and field control.

TEXT BOOKS:	
1	Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, "Highway Engineering", New Chand and Brothers", Revised 10th Edition, 2014.
2	Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna tech. Publications, New Delhi, 2015.

REFERENCES:	
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, New Delhi.
3	Guideline for the Design of Rigid Pavements for Highways, IRC 58-2018, The Indian Road Congress, New Delhi.

Cos	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	2	1	1	2	1	1	2	-	1
2	3	2	1	1	1	2	1	1	1	2	1	1	3	1	1
3	3	2	1	1	1	2	1	2	2	1	1	2	3	1	2
4	3	2	1	1	1	2	2	2	2	1	1	3	3	1	2
5	2	1	-	-	-	2	2	2	2	1	1	3	2	-	2
6	2	1	-	-	-	2	2	1	2	1	1	3	2	-	1
Overall Correlation	3	2	1	1	1	2	2	2	2	2	1	3	3	1	2

23CE048	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give an overview of Traffic engineering, various surveys to be conducted, trafficRegulation, management and traffic safety.

UNIT I	TRAFFIC SURVEYS AND ANALYSES	8

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	8

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	10

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) Road pricing, parking control, Tolls, Staggering of office/educational institution hours.		
UNIT IV	**DESIGN OF ROAD INTERSECTIONS**	**10**
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 & 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 completion of the course, the students will be able to:
CO1:	Apply the knowledge of science and engineering fundamentals in conducting traffic survey analysis.
CO2:	Identify the principles of traffic flow characteristics and their relationships.
CO3:	Utilize various traffic management measures in addressing the demand pricing and its applications.
CO4:	Identify various types of control and regulatory measures to meet an efficient traffic network.
CO5:	Plan the Road Intersection considering its merits and demerits.

CO6:	Illustrate various type of facilities and plan for Non-Motorised Transport.
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.
REFERENCES:	
1	Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.
2	Taylor MAP and Young W, Traffic Analysis – New Technology and New Solutions, Hargreen Publishing Company, 1998.
3	Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd., 1996.
4	Roger P.Roess, William R.Mcshane and Elena S.Prassas, "Traffic Engineering", Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	1	2	2	2	2	3	1	1
2	3	2	1	1	3	2	1	2	2	1	2	2	3	3	2
3	3	2	1	1	1	1	1	2	2	2	2	2	3	1	2
4	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2
5	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2
6	2	1	-	-	1	2	2	2	1	1	2	2	2	1	3
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

VERTICAL -4 – WATER RESOURCES

23CE049	WATER QUALITY AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE 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 quality modelling.

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 modelling.		
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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Identify the principles of water quality modelling.
CO2:	Illustrate pollutant transport phenomena in surface and groundwater.
CO3:	Apply the knowledge of surface water quality modelling to predict the water quality of rivers, lakes and estuary.
CO4:	Explain the Ground water Flow and its Quality modeling Concepts.
CO5:	Solve water quality of surface and sub-surface water using numerical solution.
CO6:	Compare about the models in case studies.
TEXT BOOKS:	
1	Steven C. Chapra, "Surface Water Quality Modelling", Tata McGraw-Hill Companies, Inc., New Delhi 2018.
2	Zhen-Gang Ji ,"Hydrodynamics and Water Quality: Modelling Rivers, Lakes, and Estuaries", John Wiley & Sons, 2018.
REFERENCES:	
1	Benedini, Marcello, Tsakiris, George, "Water Quality Modelling for Rivers and Streams" Springer Netherlands, 2017.
2	Jacob Bear, A. H.-D. Cheng, "Modelling Groundwater Flow and Contaminant Transport" Springer Science & Business

	Media, 2010.
3	Ne-Zheng Sun, Alexander Sun, "Mathematical Modelling of Groundwater Pollution" Springer New York, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	1	1	1	1	1	3	3	1	1
2	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
3	3	2	1	1	1	1	1	2	2	1	2	1	3	1	2
4	2	1	-	-	3	1	2	2	2	2	2	1	2	3	2
5	3	2	1	1	2	2	1	2	1	2	2	2	3	2	2
6	2	1	-	-	2	2	1	2	1	2	2	2	2	2	2
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

23CE050	GROUND WATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objective of this course is enable the student to understand the principles of Groundwater governing Equations, Characteristics of different aquifers and techniques of groundwater model development and management.

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 – GEC norms - 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	GROUND WATER 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	GROUND WATER QUALITY	9

Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water Industrial water – Irrigation water - Groundwater Pollution and legislation - Environmental Regulatory requirements.

UNIT V	**GROUND WATER 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

COURSE OUTCOMES:

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

CO1:	Outline the groundwater system basic, types of aquifers, aquifer parameters, movement and its potential for confined and unconfined aquifers.
CO2:	Explain the unsteady state flow of well hydraulics.
CO3:	Explain the necessity of ground water management model.
CO4:	Explain the mathematical model for ground water management.
CO5:	Explain the water quality standards for drinking water, industrial water and irrigation water.
CO6:	Explain the artificial recharge technique and intrusion and remediation of sea water.

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.

REFERENCES:

1	Fitts R Charles, "Groundwater Science", Elsevier, Academic Press, 2002.
2	Ramakrishnan, S, "Ground Water", K.J. Graph arts, Chennai, 1998.
3	Chahar BR, "Groundwater hydrology", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2015.
4	RastogiA.K , "Numerical Groundwater", Hydrology, 2011.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	3	1	1	1	2	1	2	2	1	1
2	2	1	-	-	2	3	1	1	2	2	2	2	2	2	1
3	2	1	-	-	3	2	2	1	2	2	2	2	2	3	1
4	2	1	-	-	3	2	2	1	2	2	2	2	2	3	1
5	2	1	-	-	3	3	2	1	2	2	2	2	2	3	1
6	2	1	-	-	3	3	2	2	2	2	2	2	2	3	2
Overall Correlation	2	2	1	1	3	3	2	2	2	2	2	2	2	3	2

23CE051	WATERSHED CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE 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 – Topo sheet - 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	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the morphological features of a watershed.
CO2:	Illustrate the oil Conservation Measures and its Concepts.
CO3:	Apply the concepts of micro catchment to design the small water harvesting structures.
CO4:	Illustrate the application of modern tools and technology in the management of watershed.
CO5:	Explain the Concepts of Watershed Management Activities.
CO6:	Develop an integrated watershed development plan.
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.
REFERENCES:	
1	Glenn O Schwab. Et.al., "Soil and Water Conservation Engineering", Wiley India Private Limited, 2009.
2	John G. Lyon., "GIS for Water Resources and Watershed Management", CRC Press, 2002.
3	Vijay P. Singh, Donald K. Frevert., "Watershed Models", CRC Press, 2005.
4	Vir Singh, Raj., "Watershed Planning and Management", Bio- Green Publisher, 2016.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	3	2	1	2	2	1	1
2	2	1	-	-	1	2	2	1	1	2	1	2	2	1	1
3	3	2	1	1	1	2	2	1	1	2	1	2	3	1	1
4	2	1	-	-	3	1	1	1	2	2	2	2	2	3	1
5	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
6	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

23CE052	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE 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.
- To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits.

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 AND REGULATORY SETTINGS	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 IWRM CONTEXT	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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the context and principles of IWRM.
CO2:	Explain the Economic Characteristics of Water.
CO3:	Illustrate the Legal and Regulatory Settings framed in the area of water Management.
CO4:	Explain UN law on non-navigable uses of international water courses.
CO5:	Develop the health impact assessment of water resources development projects.
CO6:	Explain the virtual water trade for achieving global water and food security.
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.
REFERENCES:	
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.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	1	2	2	2	2	2	1	1
2	2	1	-	-	2	2	2	2	2	2	2	2	2	2	2
3	2	1	-	-	2	2	2	2	2	2	2	2	2	2	2
4	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
5	3	2	1	1	1	2	2	2	2	2	2	2	3	1	2
6	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

23CE053	HYDROLOGY AND IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce to the students, the concepts of hydrological processes, hydrological extremes and groundwater.
- The student is exposed to different phases in irrigation practices and Planning and management of irrigation.

UNIT I	PRECIPITATION AND ABSTRACTIONS	9

Hydrological cycle - Meteorological measurements – Types and forms of precipitation - Rain gauges Spatial analysis of rainfall data using Thiessen polygon and Iso-hyetal methods - Interception – Evaporation: Measurement, Evaporation suppression methods – Infiltration: Horton’s equation - Double ring infiltrometer - Infiltration indices.

UNIT II	GROUNDWATER AND MANAGEMENT	9

Origin - Classification and types - Properties of aquifers - Governing equations – Steady and unsteady flow - Artificial recharge - RWH in rural and urban areas.

UNIT III	CROP WATER REQUIREMENT	9

Need and classification of irrigation - Historical development and merits and demerits of irrigation - Types of crops-crop season-duty, delta and base period - Consumptive use of crops - Estimation of Evapotranspiration using experimental and theoretical methods.

UNIT IV	IRRIGATION METHODS	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.

UNIT V	DIVERSION AND IMPOUNDING STRUCTURES	9
Types of Impounding structures - Gravity dam – Forces on a dam - Design of Gravity dams; Earth dams, Arch dams - Diversion Head works - Weirs and Barrages.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the spatial analysis of rainfall data and measurement of evaporation.
CO2:	Explain the properties of aquifers.
CO3:	Illustrate the consumptive use of crops.
CO4:	Calculate the evapotranspiration using experimental and theoretical methods.
CO5:	Explain the various irrigation methods.
CO6:	Explain the diversion and impounding structures.
TEXT BOOKS:	
1	Subramanya K, "Engineering Hydrology"- Tata McGraw Hill, 2010.
2	Jayarami Reddy P, "Hydrology", Tata McGraw Hill, 2008.
REFERENCES:	
1	David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007.
2	Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", Mc Graw Hill International Book Company, 1998.
3	Raghunath. H.M., "Hydrology", Wiley Eastern Ltd., 1998.
4	Bhagu R. Chahar., “Groundwater Hydrology”, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

COs	Pos												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	1	2	2	1	2	2	1	1
2	2	1	-	-	1	2	2	1	2	2	1	2	2	1	1
3	2	1	-	-	1	2	2	1	2	2	2	2	2	1	1
4	3	2	1	1	1	2	2	1	2	2	2	2	3	1	1
5	2	1	-	-	1	2	2	2	2	2	1	2	2	1	2
6	2	1	-	-	1	2	2	2	2	2	2	2	2	1	2
Overall Correlation	3	2	1	1	1	2	2	2	2	2	2	2	3	1	2

23CE054	WATER RESOURCES SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To introduce the student to the concept of Mathematical approaches for managing the water resources system and apply to operate a water resource system optimally.

UNIT I	SYSTEM APPROACH	9

Definition, classification, and characteristics of systems - Philosophy of modelling – Goals and Objectives – Basics of system analysis concept – Steps in systems engineering.

UNIT II	LINEAR PROGRAMMING	9

Introduction to Operation research - Linear programming Problem Formulation -Graphical solution Simplex method – Sensitivity analysis - Application to operation of single purpose reservoir.

UNIT III	DYNAMIC PROGRAMMING	9

Bellman's optimality criteria, problem formulation and solutions – Water Allocation for three state (user), Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion.

UNIT IV	SIMULATION	9

Basic principles and concepts – Monte Carlo techniques – Model development – Inputs and outputs Single and multipurpose reservoir simulation models – Deterministic simulation – Rule Curve development for reservoir.

UNIT V	ADVANCED OPTIMIZATION TECHNIQUES	9

Integer and parametric linear programming – Goal programming types – Applications to reservoir release optimization – application of evolutionary algorithms like Genetic

algorithm, Particle swarm, Simulated Annealing to reservoir release optimization.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the characteristics of water resources system.
CO2:	Apply the concept of linear programming for optimization of water resources problems
CO3:	Explain the concept of dynamic programming in water resources Engineering.
CO4:	Explain the basic principle and concepts of model development of water resources systems.
CO5:	Develop the simulation model based on deterministic simulation for reservoir.
CO6:	Apply of evolutionary algorithms to reservoir release optimization.
TEXT BOOKS:	
1	Vedula, S., and Majumdar, P.P., "Water Resources Systems – Modeling Techniques and Analysis", Tata McGraw Hill, New Delhi, Fifth reprint, 2010.
2	Bhave PR, Water Resources Systems, Narosa Publishers, 2011.
REFERENCES:	
1	Gupta, P.K., and Man Mohan, "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 1995.
2	Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.
3	Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.
4	Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi, 1992.

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	2	1	2	2	1	1
2	3	2	1	1	1	2	1	1	2	1	2	2	3	1	1
3	2	1	-	-	2	2	1	1	2	1	2	2	2	2	1
4	2	1	-	-	2	2	1	1	2	1	2	2	2	2	1
5	3	2	1	1	3	2	2	1	2	1	2	2	3	3	1
6	3	2	1	1	3	2	1	2	2	1	2	2	3	3	2
Overall Correlation	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2

VERTICAL -5 – GEO INFORMATICS

23CE055	AIRBORNE AND TERRESTRIAL LASER MAPPING	L	T	P	C
		3	0	0	3

COURSE 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.

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 – CommercialTLS Specifications – Mobile Mapping Lasers: Vehicle Mounted TLS, Back Pack Wearable LaserScanners – 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 completion of the course, the students will be able to:	
CO1:	Illustrate the components of laser and various platforms of laser scanning.	
CO2:	Summarize the components of Airborne Laser Scanner and concept of ranging principles.	
CO3:	Utilize the flight planning parameters and pre-processing of acquired data.	
CO4:	Utilize the data to derive DSM and DEM and its applications.	
CO5:	Illustrate the components of TLS and its applications.	

CO6:	Explain the Application of Terrestrial Laser Scanners (TLS).

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.

REFERENCES:

1	George Vosselman and Hans - Gerd Maas, "Airborne and Terrestrial Laser Scanning", Whittles Publishing, 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.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
2	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
3	3	2	1	1	1	1	1	1	1	1	1	3	3	1	1
4	3	2	1	1	2	1	1	1	1	1	1	1	3	2	1
5	2	1	-	-	2	2	1	1	1	1	2	2	2	2	1
6	2	1	-	-	2	2	1	1	1	1	2	2	2	2	1
Overall Correlation	3	2	1	1	2	2	1	1	1	1	2	2	3	2	1

23CE056	REMOTE SENSING CONCEPTS AND TECHNIQUES	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 – Lagrange 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:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the concepts and laws related to remote sensing.
CO2:	Explain the interaction of electromagnetic radiation with atmosphere.
CO3:	Explain the interaction of EMR with earth material.
CO4:	Summarize satellite orbits and different types of satellites.
CO5:	Illustrate the different types of remote sensors.
CO6:	Outline the concepts of interpretation of satellite imagery.
TEXT BOOKS:	
1	Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, "Remote Sensing and Image interpretation", John Wiley and Sons, Inc, New York,2015.
2	George Joseph and C Jeganathan, "Fundamentals of Remote Sensing", Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCES:	
1	Janza, F.Z., Blue H.M. and Johnson, J.E. “Manual of Remote Sensing”, Vol.1, American Society of Photogrametry, Virginia, USA, 2002.
2	Verbyla, David, “Satellite Remote Sensing of Natural Resources”, CRC Press, 1995.
3	Charles Elachi and Jacob Van Zyl, “Introduction to Physics and Techniques of Remote Sensing”, 2006 Edition II, Wiley Publication.
4	Basudeb Bhatta, “Remote Sensing and GIS”, Oxford University Press, 2011.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	1	1	1	1	1	1	2	2	2	1
2	2	1	-	-	2	1	1	1	1	1	1	1	2	2	1
3	2	1	-	-	2	1	1	1	1	1	1	1	2	2	1
4	2	1	-	-	2	1	1	1	1	1	1	2	2	2	1
5	2	1	-	-	3	1	1	1	1	1	1	2	2	3	1
6	2	1	-	-	3	1	1	1	1	1	1	2	2	3	1
Overall Correlation	2	1	-	-	3	1	1	1	1	1	1	2	2	3	1

23CE057	SATELLITE IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE 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 completion of the course, the students will be able to:
CO1:	Illustrate Remote sensing and Image processing systems
CO2:	Infer about the source of error in satellite image and also to remove the error from satellite image.
CO3:	Choose appropriate image Enhancement techniques based on image characteristics.
CO4:	Illustrate the satellite image using various method.
CO5:	Interpret the Accuracy of Classification.
CO6:	Utilize the advanced image classification methods and conduct lifelong researching the field of image processing.
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.
REFERENCES:	
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	Rafael C. Gonzalez, Richard Eugene “Digital Image Processing” - Woods Pearson, Prentice Hall, 2008.
4	Annadurai , “Fundamentals of Digital Image Processing” Pearson Education 2006.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	1	1	1	1	1	1	2	2	3	1
2	2	1	-	-	3	1	1	1	1	1	1	2	2	3	1
3	3	2	1	1	3	1	2	2	1	2	2	2	3	3	2
4	2	1	-	-	3	2	2	2	2	2	2	2	2	3	2
5	2	1	-	-	3	2	2	2	2	2	2	2	2	3	2
6	3	2	1	1	3	2	2	2	1	2	2	2	3	3	2
Overall Correlation	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2

23CE058	CARTOGRAPHY AND GIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Introduce concepts of Cartography and GIS.
- Expose the process of map-making and production.
- Introduce GIS data structures, data input and data presentation.

UNIT I	ELEMENTS OF CARTOGRAPHY	9

Definition 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.

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 Transformations.

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 completion of the course, the students will be able to:	
CO1:	Explain appropriate map projection and co-ordinate system for production of Maps and shall able to compile and design maps for their required purpose.
CO2:	Explain co-ordinate and Datum transformations.
CO3:	Summarize the basic concepts and components of GIS, the techniques used for storage of spatial data and data compression.
CO4:	Summarize the data input and topology.
CO5:	Summarize the concept of spatial data quality and data standard.
CO6:	Summarize the concept of spatial data inputs.
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.

REFERENCES:	
1	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju., "An Introduction to Geographical Information Systems", Pearson Education, Fourth Edition, 2011.
2	John Campbell Wm. C., "Introductory Cartography", Brown Publishers, 3rd Edition, 2004.
3	Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", Pearson Education, 2nd Edition, November 2016, ISBN: 9789332581883.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	-	-	-	1	-	1	2	1	-
2	2	1	-	-	1	1	-	-	-	1	-	1	2	1	-
3	2	1	-	-	3	1	-	-	-	1	-	1	2	3	-
4	2	1	-	-	2	1	-	-	-	1	-	1	2	2	-
5	2	1	-	-	2	2	-	-	-	1	-	1	2	2	-
6	2	1	-	-	2	1	-	-	-	1	-	1	2	2	-
Overall Correlation	2	1	-	-	2	1	-	-	-	1	-	1	2	2	-

<table>
<tr><td colspan="2" rowspan="2">23CE059</td><td rowspan="2">PHOTOGRAMMETRY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">To introduce basics and concepts of optics, aerial photography acquisition and mapping from aerial photographs.</td></tr>
<tr><td>UNIT I</td><td colspan="5">PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY</td><td>9</td></tr>
<tr><td colspan="7">History – 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 Planning.</td></tr>
<tr><td>UNIT II</td><td colspan="5">GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS</td><td>9</td></tr>
<tr><td colspan="7">Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – Parallax equations - Geometry, Scale, Coordinate system – Relief displacement – Photo Interpretation.</td></tr>
<tr><td>UNIT III</td><td colspan="5">STEREO PLOTTERS & ORIENTATION</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">AERO TRIANGULATION, TERRAIN MODELING, ORTHOPHOTO</td><td>9</td></tr>
<tr><td colspan="7">Neat model – Strip and blocks of photographs – Aero triangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aero triangulation (INS and</td></tr>
</table>

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 – Workstation 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 completion of the course, the students will be able to:
CO1:	Summarize the principles and properties of photography.
CO2:	Interpret geometrical properties of Aerial photographs.
CO3:	Model the tracking system and its orientation.
CO4:	Summarize the Aero triangulation, terrain modeling, and orthophoto.
CO5:	Interpret digital photogrammetry workstation and its basic system function.
CO6:	Apply the stereoscopic system and the principles of satellite photogrammetry.
TEXT BOOKS:	
1	Paul. R Wolf., Bon A. De Witt, "Elements of Photogrammetry with Application in GIS" McGraw Hill International Book Co., 4th Edition, 2014.
2	E. M. Mikhail, J. S. Bethel, J. C. McGlone, "Introduction to Modern Photogrammetry", Wiley Publisher, 2001.
REFERENCES:	
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	R. S by Albert. D, "Manual of Photogrammetry" American Society of Photogrammetry & amp, 1980.
4	Y. Egels & amp; Michel Kasser, "Digital Photogrammetry" Taylor & amp; Francis group, 2003.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	2	2	-	2	-	2	2	2
2	2	1	-	-	2	2	-	2	2	-	2	-	2	2	2
3	3	2	1	1	3	2	-	2	2	-	2	-	3	3	2
4	2	1	-	-	3	2	2	2	2	-	2	2	2	3	2
5	2	1	-	-	3	2	2	2	2	-	2	2	2	3	3
6	3	2	1	1	3	2	2	2	2	-	2	2	3	3	2
Overall Correlation	3	2	1	1	3	2	2	2	2	-	2	2	3	3	3

23CE060	HYDROGRAPHIC SURVEYING	L	T	P	C
		3	0	0	3

COURSE 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.

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 completion of the course, the students will be able to:
CO1:	Summarize the fundamentals of hydrographic surveying.
CO2:	Identify the appropriate techniques for different types of surveys.
CO3:	Compare the various options available during the Navigation.
CO4:	Make use of the data collected from a survey and assess its quality against the project requirements.
CO5:	Interpret the different roles of a hydrographic surveyor on marine projects.
CO6:	Apply the measures for the marine environment.
TEXT BOOKS:	
1	U.S. Army Corps of Engineers, "Hydrographic Surveying", Document No. EM 1110-2-1003, 2002.
2	Pugh, D, "Changing Sea Levels – Effects of Tides, Weather and Climate", Cambridge University Press, 2004.
REFERENCES:	
1	De Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A., "Hydrography", Delft University Press, The Netherlands, 2002.
2	Ingham, A. E., "Hydrography for the Surveyor and Engineer", 3rd Edition revised by Abbott V. J., Blackwell Science, 1992.
3	International Hydrographic Organisation, "IHO Standards for Hydrographic Surveying (S44)", IHB Monaco, 1998.

4	Loweth, R. P, "Manual of Offshore Surveying for Geoscientists and Engineers", Chapman & Hall, 1997.

COs	Pos												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	3	-	2	2	-	2	-	2	2	2
2	3	2	1	1	2	3	-	2	2	-	2	2	3	2	2
3	2	1	-	-	2	3	-	2	2	-	2	-	2	2	2
4	3	2	1	1	2	3	2	2	3	-	2	2	3	2	2
5	2	1	-	-	3	3	2	3	2	-	2	2	2	3	3
6	3	2	1	1	3	3	2	2	2	-	2	2	3	3	2
Overall Correlation	3	2	1	1	3	3	2	3	3	-	2	2	3	3	3

VERTICAL -6 – CONSTRUCTION TECHNIQUES

23CE061	FORMWORK ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Make the students to learn the detailed planning of formwork, design of forms, and erection of formwork.
- Impart the knowledge about different types of formwork used for special structures.

UNIT I	INTRODUCTION TO FORMWORK	9

Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples - Overall Planning - Detailed planning - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork.

UNIT II	FORMWORK MATERIALS ACCESSORIES& PRESSURES	9

Formwork Materials, Accessories and consumables – Application of tools, Reconstituted wood - Steel – Aluminum Plywood - Types and grades Standard units - Corner units – Pass units, Calculation of labour constants - Formwork hours - Labour Requirement. Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Finish - Sheathing boards working stresses - Repetitive member stress Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

UNIT III	FORMWORK DESIGN	9

Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures,

Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.		
UNIT IV	**FORMWORK FOR SPECIAL STRUCTURES**	**9**
Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.		
UNIT V	**CASE STUDIES**	**9**
Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members – improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – Failure formwork issues in multi - story building construction – Vertical and horizontal elements used in the industry.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the overall and detailed planning of formwork.
CO2:	Interpret the knowledge on formwork materials, accessories, pressures and labour requirement.
CO3:	Infer the conceptual understanding of design, construction and erection of formwork.
CO4:	Outline the knowledge about different types of form work used for special structures.
CO5:	Interpret the errors in design of formwork.
CO6:	Outline the formwork failures using case studies.
TEXT BOOKS:	
1	Peurify R.L and Oberlender G.D , "Formwork for Concrete Structures", McGraw Hill Education India , 2015.

2	Jha K N, "Formwork for Concrete Structures", Tata McGraw Hill Education, 2012.
REFERENCES:	

1	Austin, C.K., "Formwork for Concrete", Cleaver -Hume Press Ltd., London, 1996.
2	Hurd, M.K., "Formwork for Concrete", Special Publication No.4, American Concrete Institute, Detroit, 1996.
3	Michael P. Hurst, Construction Press, London and New York, 2003.
4	Christopher Souder, "Temporary Structure Design", Wiley Publications, London, 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	1	2	1	2	1	2	2	2	2
2	2	1	-	-	2	2	2	2	1	1	2	2	2	2	2
3	2	1	-	-	2	2	1	2	1	2	2	2	2	2	2
4	2	1	-	-	2	2	2	2	1	1	2	2	2	2	2
5	2	1	-	-	2	2	2	2	1	1	1	2	2	2	2
6	2	1	-	-	2	2	1	2	1	1	2	2	2	2	2
Overall Correlation	2	1	-	-	2	2	2	2	1	1	2	2	2	2	2

23CE062	SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:		
To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.		
UNIT I	**SUSTAINABLE CONSTRUCTION MATERIALS**	**9**
Introduction and definition of Sustainability - Carbon cycle - Role of construction material: concrete and steel, etc. - CO_2 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 completion of the course, the students will be able to:	
CO1:	Outline the various sustainable materials used in construction.
CO2:	Explain the method of estimating the amount of energy required for building.
CO3:	Summarize the features of LEED, TERI and GRIHA ratings of buildings.
CO4:	Explain about insulation and thermal properties of construction materials.
CO5:	Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO6:	Apply lean tools & techniques to achieve sustainability in construction projects.
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.
REFERENCES:	
1	Ballard, G., Tommelein, I., Koskela, L. and Howell, G., "Lean construction tools and techniques", 2002.
2	Salem, O., Solomon, J., Genaidy, A. and Luegring, M., "Site implementation and Assessment of Lean Construction Techniques", Lean Construction Journal, 2005.
3	Jerry Yudelson, "The Green Building Revolution", Island Press, 2nd Edition, 2013.

4	B.R. Gujar and P.S. Shukla, "Building materials for sustainable and energy efficient construction," Springer, 2020.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	3	1	1	-	2	1	2	-	1
2	2	1	-	-	1	2	2	-	1	1	1	2	2	1	-
3	2	1	-	-	1	1	1	-	-	-	2	1	2	1	-
4	2	1	-	-	1	1	1	-	-	-	2	1	2	1	-
5	2	1	-	-	2	1	2	1	1	1	2	2	2	2	1
6	3	2	1	1	2	2	2	1	-	1	2	2	3	2	1
Overall Correlation	3	2	1	1	2	2	2	1	1	1	2	2	3	2	1

<table>
<tr><td rowspan="2">23CE063</td><td rowspan="2">CONSTRUCTION PLANNING AND SCHEDULING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="6">To make the students to learn about planning of construction projects, scheduling procedures and techniques, cost and quality control projects and use of project information as decision making tool.</td></tr>
<tr><td>UNIT I</td><td colspan="4">CONSTRUCTION PLANNING</td><td>9</td></tr>
<tr><td colspan="6">Basic concepts in the development of construction plans - Choice of Technology and Construction method - Defining Work Tasks – Definition - Precedence relationships among activities - Estimating Activity Durations-Estimating Resource Requirements for work activities - Coding systems.</td></tr>
<tr><td>UNIT II</td><td colspan="4">SCHEDULING PROCEDURES AND TECHNIQUES</td><td>9</td></tr>
<tr><td colspan="6">Relevance of construction schedules-Bar charts – The critical path method-Calculations for critical path scheduling - Activity float and schedules - Presenting project schedules - Critical path scheduling for Activity-on-node and with leads, Lags and Windows - Calculations for scheduling with leads, lags and windows - Resource oriented scheduling - Scheduling with resource constraints and precedences -Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost tradeoffs -Improving the Scheduling process – Introduction to application software.</td></tr>
<tr><td>UNIT III</td><td colspan="4">COST CONTROL MONITORING AND ACCOUNTING</td><td>9</td></tr>
<tr><td colspan="6">The cost control problem-The project budget-Forecasting for Activity cost control – financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule and Budget updates-Relating cost and schedule information.</td></tr>
</table>

UNIT IV	**QUALITY CONTROL AND SAFETY DURING CONSTRUCTION**	**9**
Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.		
UNIT V	**ORGANIZATION AND USE OF PROJECT INFORMATION**	**9**
Types of project information-Accuracy and Use of Information-Computerized organization and use of Information – Organizing information in databases -Relational model of Data bases - Other conceptual Models of Databases - Centralized database Management systems - Databases and application programs-Information transfer and Flow.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize basic concepts of construction planning.
CO2:	Interpret and schedule the construction activities.
CO3:	Infer the forecast and control the cost in a construction.
CO4:	Outline the quality control and safety during construction.
CO5:	Interpret project information and the use of information.
CO6:	Outline the information in Centralized database Management systems.
TEXT BOOKS:	
1	Chitkara, K.K.. "Construction Project Management Planning, Scheduling and Control", Tata McGraw Hill Publishing Co., New Delhi, 2009.
2	Srinath, L.S., "PERT and CPM Principles and Applications", Affiliated East West Press, 2001.

REFERENCES:	
1	Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamentals Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pitsburgh, 2000.
2	Moder.J., Phillips. C. and Davis E, "Project Management with CPM, PERT and Precedence Diagramming", Van Nostrand Reinhold Co., 3rd Edition, 1985.
3	Willis., E.M., "Scheduling Construction projects", John Wiley and Sons, 1986.
4	Halpin, D.W., "Financial and Cost Concepts for Construction Management", John Wiley and Sons, New York, 1985.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	1	2	1	2	1	2	2	2	2
2	2	1	-	-	2	2	2	2	2	1	2	2	2	2	2
3	2	1	-	-	2	2	1	2	2	2	2	2	2	2	2
4	2	1	-	-	2	2	2	2	2	1	2	2	2	2	2
5	2	1	-	-	2	2	2	2	1	1	1	2	2	2	2
6	2	1	-	-	2	2	1	2	2	1	2	2	2	2	2
Overall Correlation	2	1	-	-	2	2	1	2	2	1	2	2	2	2	2

23CE064	CONSTRUCTION TECHNIQUES, EQUIPMENT AND	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities.
- Impart the knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.

UNIT I	CONSTRUCTION TECHNIQUES	9

Structural systems - Load Bearing Structure - Framed Structure - Load transfer mechanism – floor system - Development of construction techniques - High rise Building Technology - Seismic effect - Environmental impact of materials – responsible sourcing - Eco Building (Green Building) - Material used - Construction methods - Natural Buildings - Passive buildings - Intelligent(Smart) buildings - Meaning - Building automation - Energy efficient buildings for various zones-Case studies of residential, office buildings and other buildings in each zones.

UNIT II	CONSTRUCTION PRACTICES	9

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – Marking – Earthwork - Masonry – Stone masonry – Bond in masonry - Concrete hollow block masonry – flooring – Damp proof courses – Construction joints – Movement and expansion joints – Pre cast pavements – Building foundations – basements – Temporary shed – centering and shuttering – Slip forms – Scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – Frames – Braced domes – Laying brick – Weather and water proof – Roof finishes – Acoustic and fire protection.

UNIT III	**SUB STRUCTURE CONSTRUCTION**	**9**
Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement -Tunneling techniques – Piling techniques - Well and caisson - sinking cofferdam - Cable anchoring and grouting - Driving diaphragm walls, sheet piles - Shoring for deep cutting - Well points - Dewatering and stand by Plant equipment for underground open excavation.		
UNIT IV	**SUPER STRUCTURE CONSTRUCTION**	**9**
Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Launching girders, bridge decks, off shore platforms – Special forms for shells - Techniques for heavy decks – in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks.		
UNIT V	**CONSTRUCTION EQUIPMENT**	**9**
Selection of equipment for earth work - Earth moving operations - Types of earthwork equipment - Tractors, motor graders, scrapers, front end waders, earth movers – Equipment for foundation and pile driving. Equipment for compaction, batching, mixing and concreting - Equipment for material handling and erection of structures – Types of cranes - Equipment for dredging, trenching, tunneling.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize the different construction techniques and structural systems.	
CO2:	Interpret various techniques and practices on masonry construction, flooring, and roofing.	

CO3:	Infer the plan and requirements for substructure construction.
CO4:	Outline the methods and techniques involved in the construction of various types of superstructures.
CO5:	Interpret to select, maintain, and operate hand and power tools.
CO6:	Outline the equipment used in the building construction sites.
TEXT BOOKS:	
1	Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997.
2	Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.
REFERENCES:	
1	Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 1999.
2	Sharma S.C. "Construction Equipment and Management", Khanna Publishers New Delhi, 2002.
3	Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2012.
4	Mahesh Varma, "Construction Equipment and its Planning and Application", Metropolitan Book Company, New Delhi, 1983.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	1	2	1	2	1	2	2	2	2
2	2	1	-	-	2	2	2	2	1	1	1	2	2	2	2
3	2	1	-	-	2	2	1	2	2	2	1	2	2	2	2
4	2	1	-	-	2	2	2	2	2	1	1	2	2	2	2
5	2	1	-	-	2	2	2	2	2	1	1	2	2	2	2
6	2	1	-	-	2	2	1	2	2	1	1	2	2	2	2
Overall Correlation	2	1	-	-	2	2	1	2	2	1	1	2	2	2	2

<table>
<tr><td colspan="2">23CE065</td><td rowspan="2">ENERGY EFFICIENT BUILDINGS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">To provide an understanding of the concept of energy consumption in buildings and design an energy efficient building.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT II</td><td colspan="5">PASSIVE SOLAR HEATING AND COOLING</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT III</td><td colspan="5">DAYLIGHTING AND ELECTRICAL LIGHTING</td><td>9</td></tr>
<tr><td colspan="7">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</td></tr>
</table>

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 completion of the course, the students will be able to:
CO1:	Explain energy conservation strategies for buildings.
CO2:	Explain the passives heating, cooling system.
CO3:	Infer the various aspects of day-lighting and electrical lighting in a building.
CO4:	Plan building ventilation and heat control for indoor comfort.

CO5:	Plan a building for climatic zone involving energy-efficient systems, and renewable energy integration.
CO6:	Solve energy efficiency, optimize design parameters, and ensure regulatory compliance for energy-efficient buildings in temperate zones.
TEXT BOOKS:	
1	Energy Conservation Building Code, cau of Energy Efficiency, New Delhi, 2018.
2	“Handbook on Functional Requirements of Buildings Part 1 to 4” SP: 41 (S and T) 1995.
REFERENCES:	
1	John Krigger and Chris Dorsi, “Residential Energy: Cost Savings and Comfort for Existing Buildings” Published by Saturn Resource Management, 2013.
2	Brown, G.Z. and DeKay, M., “Sun, Wind and Light - Architectural Design Strategies”, John Wiley and Sons Inc,3^{rd} Edition, 2014.
3	Majumdar, M (Ed), “Energy - Efficient Buildings in India”, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	2	2	2	-	2	2	-	2
2	2	1	-	-	-	-	-	2	-	2	-	-	2	-	2
3	2	1	-	-	-	-	-	2	-	2	-	-	2	-	2
4	3	2	1	1	-	-	1	2	-	2	-	-	3	-	2
5	3	2	1	1	2		1	2	2	2	-	-	3	2	2
6	3	2	1	1	2		1	2	2	2	-	-	3	2	2
Overall Correlation	3	2	1	1	1	1	1	2	2	2	-	1	3	1	2

23CE066	RAINWATER HARVESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge and skills relevant to water conservation and management towards achieving the sustainability in water resources and relate the engineering principles and practices in estimation of runoff, storage, recharge into the ground and maintain the system through the best management practices followed around the world.

UNIT I	BASICS OF RAIN WATER HARVESTING	8

Water and its sources - Need for water conservation – Types of water demand - Conservation Methods-Global and Indian perspectives - National mission and goals towards rainwater harvesting – National water policy - Legislation on rainwater harvesting in India and Tamil Nadu.

UNIT II	HYDROLOGY AND GROUND WATER	10

Hydrological cycle – Precipitation - Rainfall measurement - Rain-gauges – Hyetograph - Infiltration - Runoff estimation – Rooftop runoff estimation. Ground water - Aquifer Properties – Darcy law and well hydraulics - Steady flow.

UNIT III	METHODS OF RAINWATER HARVESTING	7

Rainwater harvesting potential of an area - Traditional harvesting practices – Rooftop harvesting - Methods of RWH structures – Site selection for rainwater harvesting - Surface runoff Harvesting - Ground water recharge - Artificial recharge.

UNIT IV	DESIGN OF RAINWATER HARVESTING STRUCTURES	10

Design Considerations - Components of Rainwater harvesting system - Simple roof water collection system - Design of Storage structure - Design of Recharge structures – Recharge pit - Recharge trench - Recharge well - Gully plug - Contour bund - Percolation tank - Check dam - Recharge shaft - Efficiency of RWH system.

UNIT V	MANAGEMENT OF RWH AND CASE STUDIES	10
Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems – Maintenance of RWH structures - Modernization of RWH system - Case studies on best practice of RWH in urban - Success stories of Contemporary practices of RWH in India.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the need and importance of water conservation through global and Indian practices of rainwater harvesting.
CO2:	Explain the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials.
CO3:	Outline the various types of rainwater harvesting methods and apply it on the field.
CO4:	Model the various RWH structures to harvest the rainwater in surface and subsurface.
CO5:	Explain the difficulties of RWH.
CO6:	Explain the methods and maintenance of RWH through various case studies.
TEXT BOOKS:	
1	H.M Raghunath, "Ground Water", 3rd Edition, New Age International, 2007.
2	Jayarami Reddy. P., "A Text book of Hydrology," Firewall media Publication, 2005.
REFERENCES:	
1	Proceedings of UNHABITAT Blue water series "Rainwater harvesting and utilization", Book 2 beneficiaries and capacity builders.
2	"Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water Resources", Central Ground Water Board Faridabad, 2003.

3	"Rainwater Harvesting: Indian Railway Institute of Civil Engineering", Pune, October 2015.
4	A Manual on "Rainwater Harvesting and Conservation": Government of India, Consultancy Service Organization Central Public Works Department, New Delhi.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	2	2	2	1	1	1	2	2	1	2
2	2	1	-	-	3	2	1	1	1	1	2	2	2	3	1
3	2	1	-	-	3	2	1	1	1	1	2	2	2	3	1
4	3	2	1	1	2	2	2	1	1	1	1	2	3	2	1
5	2	1	-	-	3	2	2	2	2	1	2	2	2	3	2
6	2	1	-	-	2	2	2	2	2	1	2	2	2	2	2
Overall Correlation	3	2	1	1	3	2	2	2	2	1	2	2	3	3	2

VERTICAL -7 – ENVIRONMENT

23CE067	CLIMATE CHANGE ADAPTATION AND MITIGATION	L	T	P	C
		3	0	0	3

COURSE 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	9

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	9

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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline about carbon cycle, physical basis of the natural greenhouse effect, measures to adapt and to mitigate the impacts of climate change.
CO2:	Explain the growing scientific consensus established through the IPCC as well as the complexities and uncertainties.
CO3:	Plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy.
CO4:	Illustrate climate models.
CO5:	Develop the model outputs for climate impact assessment.
CO6:	Explain about adaptation strategies.
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 and II. Science Publishers, 2005.
REFERENCES:	
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.

4	Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	1	-	-	-	-	2	2	-	-
2	2	1	-	-	-	2	1	-	-	-	-	-	2	-	-
3	3	2	1	1	3	-	2	-	-	-	-	3	3	3	-
4	2	1	-	-	3	-	2	-	2	-	-	-	2	3	-
5	3	2	1	1	3	2	2	-	2	-	-	2	3	3	-
6	2	1	-	-	3	2	2	-	2	-	-	2	2	3	-
Overall Correlation	3	2	1	1	3	2	2	-	2	-	-	3	3	3	-

23CE068	AIR AND NOISE POLLUTION CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE 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

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline Air Pollution and the Air Quality Criteria and its Standards.
CO2:	Interpret the Sources of air Pollution and its Effects and Classifications.
CO3:	Illustrate the Air Quality Modelling and the Dispersion of air pollutant.
CO4:	Explain the methods of air pollution Control.
CO5:	Summarize the Principles and design of Control of Gaseous Emission.
CO6:	Summarize the Sources, Effects and Control of Noise Pollution.
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.

REFERENCES:	
1	Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, New Delhi, 2000.
2	Peterson and E.Gross Jr., “Hand Book of Noise Measurement”, 7th Edition, 1974.
3	Mukherjee, "Environmental Pollution and Health Hazards, causes and effects”, 1986.
4	Antony Milne, “Noise Pollution: Impact and Counter Measures”, David & Charles PLC, 1979.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	1	2	1	2	-	-	2	-	2
2	2	1	-	-	3	-	1	-	-	-	-	2	2	3	-
3	2	1	-	-	-	-	2	-	-	-	2	-	2	-	-
4	2	1	-	-	3	-	2	-	-	-	2	-	2	3	-
5	2	1	-	-	3	-	2	-	-	-	-	-	2	3	-
6	2	1	-	-	2	-	2	-	-	2	-	-	2	2	-
Overall Correlation	2	1	-	-	2	-	2	1	1	1	1	1	2	2	1

<table>
<tr><td rowspan="2">23CE069</td><td rowspan="2" colspan="2">ENVIRONMENTAL IMPACT ASSESSMENT</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT II</td><td colspan="5">IMPACT INDENTIFICATION AND PREDICTION</td><td>10</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT III</td><td colspan="5">SOCIO-ECONOMIC IMPACT ASSESSMENT</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline the Development of Environmental Impact Assessment (EIA) and Mitigation.
CO2:	Interpret the Prediction Methods of assessments of Impacts.
CO3:	Summarize the Socio – Economic impact Assessment and Rehabilitation.
CO4:	Outline the environmental Management plan and Policies.
CO5:	Illustrate the Findings of EIA Documentation and Management.
CO6:	Summarize the EIA in Various Construction Projects through case Studies.
TEXT BOOKS:	
1	Peurify R.L and Oberlender G.D , “Formwork for Concrete Structures”, McGraw Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York. 1996.
2	Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley-Inter science, New Jersey. 2003.

REFERENCES:	
1	World Bank –Source book on EIA.
2	Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3	Kolluru Rao, Bartell Steven, Pitblado R and Stricoff “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York, 1996.
4	K. V. Raghavan and A A. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual by CLRI, 1990.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	2	-	-	-	-	2	-	3
2	2	1	-	-	2	-	-	2	2	-	-	1	2	2	3
3	2	1	-	-	2	-	-	2	2	-	-	1	2	2	3
4	2	1	-	-	3	2	2	2	2	1	1	-	2	3	2
5	2	1	-	-	-	-	-	2	-	-	-	-	2	-	2
6	2	1	-	-	1	1	-	2	-	-	-	-	2	1	2
Overall Correlation	2	1	-	-	2	1	1	2	2	1	1	1	2	2	3

23CE070	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge and skills relevant to minimization, storage, collection, transport, recycling, processing and disposal of solid and hazardous wastes including the related regulations, engineering principles, design criteria, methods and equipment.

UNIT I	WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS	9

Sources and types of solid and hazardous wastes – Need for solid and hazardous waste management – Salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries – Elements of integrated waste management and roles of stakeholders - Seven elements and seven step approach to integrated solid waste management planning.

UNIT II	WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING	9

Waste sampling and characterization plan - waste generation rates and variation – physical composition, chemical and biological properties – Hazardous characteristics – Ignitability, corrosivity and TCLP tests – Source reduction, segregation and onsite storage of wastes – Waste exchange - Extended producer responsibility - Recycling of plastics, C&D wastes and E wastes.

UNIT III	WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY	9

Door to door collection of segregated solid wastes - Analysis of hauled container and stationery container collection systems - Compatibility, storage, labeling and handling of hazardous wastes – Principles and design of transfer and transport facilities - Hazardous waste transport and manifests - Mechanical processing

and material separation technologies – Size reduction – Size separation - Density separation - Magenetic separation – Compaction – Principles and design of material recovery facilities – Physico chemical treatment of hazardous wastes - Solidification and stabilization – Case studies on waste collection and material recovery.		
UNIT IV	**BIOLOGICAL AND THERMAL PROCESSING OF WASTES**	**9**
Biological and thermos - Chemical conversion technologies – Composting – biomethanation – Incineration – Pyrolysis- plasma arc gasification –Principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty By-products - Operation of facilities and environmental controls - Treatment of biomedical wastes – Case studies and emerging waste processing technologies.		
UNIT V	**WASTE DISPOSAL**	**9**
Sanitary and secure landfills - Components and configuration– Site selection - Liner and cover systems - Geo synthetic clay liners and geo membranes - Design of sanitary landfills and secure landfills - Leachate collection, treatment and landfill gas management – Landfill construction and operational controls - Landfill closure and environmental monitoring – Landfill bioreactors – Rehabilitation of open dumps and biomining of dumpsites - Remediation of contaminated sites- Case studies.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the Sources and Types of Solid and Hazardous waste With Its Regulatory Requirements.	
CO2:	Summarize the Plan of Waste Sampling Characteristics and Source Reduction.	
CO3:	Outline the Solid and Hazardous Waste Collection and Transport System.	

CO4:	Interpret the Method of Waste Separation and Recovery of Materials.
CO5:	Illustrate the Biological and Thermal Processing of Waster.
CO6:	Summarize the Waste disposal System and Landfills.
TEXT 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.
REFERENCES:	
1	William A. Worrell, P. Aarne Vesilind, Christian Ludwig, “Solid Waste Engineering – A Global Perspective”, 3rd Edition, Cengage Learning, 2017.
2	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.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	2	-	-	-	-	-	2	-	-
2	2	1	-	-	2	-	-	-	2	-	-	-	2	2	-
3	2	1	-	-	2	-	2	-	2	-	-	-	2	2	-
4	2	1	-	-	-	-	-	-	2	-	-	-	2	-	-
5	2	1	-	-	-	2	2	-	-	-	-	-	2	-	-
6	2	1	-	-	2	-	-	-	-	-	-	-	2	2	-
Overall Correlation	2	1	-	-	1	1	1	-	1	-	-	-	2	1	-

23CE071	ENVIRONMENTAL HEALTH AND SAFETY	L	T	P	C
		3	0	0	3
COURSE 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 workplaces - 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 HEALTHAND HYGIENE**				**9**
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**				**9**
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**				**9**
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	9
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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the need for EHS in industries and related Indian regulations.
CO2:	Classify the various types of Occupational Health Hazards and Control Measures.
CO3:	Outline the Workplace safety and Safety Systems.
CO4:	Summarize the Hazards and Risk Management Techniques in Workplace.
CO5:	Outline the Onsite and Offsite Emergency Plans and Employee Participation in Education and Training of Safety Policies.
CO6:	Interpret the elements of Environmental Health and Safety Management Policy.
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.
REFERENCES:	
1	Brian Gallant, “The Facility Manager's Guide to Environmental Health and Safety” Government Industry Publications, 2007.
2	Bill Taylor, “Effective Environmental, Health, and Safety Management Using the Team Approach” Culinary and Hospitality Industry Publications Services, 2005.

3	Nicholas P. Cheremisin off and Madelyn L. Graffia, “Environmental and Health and Safety Management” William Andrew Inc.NY, 1995.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	1	2	2	-	1	2	2	-	2
2	2	1	-	-	-	-	1	-	2	-	-	3	2	-	-
3	2	1	-	-	-	-	-	-	2	-	-	3	2	-	-
4	2	1	-	-	3	2	1	1	2	-	2	3	2	3	1
5	2	1	-	-	-	1	2	-	-	-	-	-	2	-	-
6	2	1	-	-	2	-	-	-	1	-	1	-	2	2	-
Overall Correlation	2	1	-	-	1	2	1	1	2	-	1	2	2	1	1

23CE072	ENVIRONMENTAL QUALITY MONITORING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To educate the students on the sample collection and various instrumental methods of monitoring the quality of air, water and solid waste.

UNIT I	MONITORING AND CHARACRATERIZATION OF ENVIRONMENT	9

General approach to environmental analysis, Choice of Lab. Vs. Field analysis, Environmental monitoring - Current and future status, Lab. Standards, Data quality objectives, statistics in environmental monitoring, Accuracy and precision, detection limit, types of errors, Automated Data acquisition and processing –sensors and transducers ,Monitoring Network and real time monitoring.

UNIT II	ENVIRONMENTAL SAMPLING	9

Location, planning, sampling equipment's for water, solids and air, sample storage for physical and chemical contaminants, types of sampling, representative samples, sample preparation techniques – Solvent Extraction, SPE, Headspace ,Purge and trap and SPME.

UNIT III	WATER ANALYSIS	9

Techniques for analysis of major ions – UV - Visible Spectrophotometer, Flame photometer, AAS, ICP (AES and MS), Trace organic pollutan4ts (PCB, dioxins, pecticides) GC and HPLC (Columns Detectors and Application).

UNIT IV	ATMOSPHERIC ANALYSIS	9

Ambient air and flue gas, Gaseous pollutants – Determination of time weighted average concentration (Absorption trains, solid adsorbents and differential tubes), Direct reading instruments (fluorescence, chemiluminescent, IR and Electrochemical sensors), GC-MS for trace organics, Particulate sampling methods - High

volume sampler, personal sampler, PM 10 and 2.5, Metals Direct (XRF) and dissolution methods(AAS/AES).		
UNIT V	**ANALYSIS OF SOIL AND WASTE**	**9**
Problem in analysis of soil and Waste-sampling, pretreatment – Extraction and cleanup, New extraction techniques, Automated soxhlet and solventex traction, micro wave digestion and sonication, SCF(CO_2), Analysis for trace pollutants, Analysis of leachate.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Illustrate the basics of environmental monitoring.
CO2:	Choose Appropriate environmental Sampling Protocol for Physical and Chemical Analysis.
CO3:	Outline various methods of analysis of pollutants in water.
CO4:	Outline the Various Methods of Analysis of Gaseous Pollutants in Ambient air.
CO5:	Summarize the Sampling Methods for Analysis of Toxic Pollutants in air.
CO6:	Explain the Method of analysis of Trace Pollutants and Leachate from soil and Waste.
TEXT BOOKS:	
1	Reeve, R.N., "Introduction to Environmental Analysis", Analytical Techniques in the Sciences, John Wiley & Sons, Chichester, UK, 2002.
2	Barcelo,D. (editor), "Environmental analysis. Techniques, Applications and Quality Assurance", Elsevier, The Netherlands, 1996.
REFERENCES:	
1	Paul R, "Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications", Marcel Dekker; 2nd Edition, 2005.
2	Janick Artiola, Ian Pepper and Mark Brusseau,

	"Environmental Monitoring And Characterization", Academic Press, 2004.

COs	Pos												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	-	2	-	-	2	2	2	2	3	-
2	3	2	1	1	2	-	-	2	-	-	-	2	3	2	2
3	2	1	-	-	3	-	2	-	-	-	-	-	2	3	-
4	2	1	-	-	3	2	-	-	-	-	-	-	3	3	-
5	2	1	-	-	3	2	2	-	-	-	-	-	2	3	-
6	2	1	-	-	3	2	2	-	-	2	-	-	2	3	-
Overall Correlation	3	2	1	1	3	2	2	1	-	1	1	1	3	3	1

VERTICAL -8 – OCEAN ENGINEERING

<table>
<tr><td rowspan="2">23CE073</td><td colspan="2" rowspan="2">OCEAN WAVE DYNAMICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT I</td><td colspan="5">CONSERVATION EQUATIONS OF FLUID FLOW</td><td>9</td></tr>
<tr><td colspan="7">Basic equations – Conservation of mass, moment and Energy - Continuity Equation, Euler's Equation, Newtonian Fluids, Navier-Stokes Equation.</td></tr>
<tr><td>UNIT II</td><td colspan="5">WAVE THEORIES</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT III</td><td colspan="5">WAVE KINEMATICS</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">WAVE TRANSFORMATIONS</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>UNIT V</td><td colspan="5">WAVE ANALYSIS</td><td>9</td></tr>
<tr><td colspan="7">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.</td></tr>
</table>

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Summarize the concept of mass, momentum and wave energy transformations.
CO2:	Classify the linear and nonlinear wave theories.
CO3:	Explain the wave kinematics and its properties.
CO4:	Outline the principles of wave transformation.
CO5:	Solve wave parameters of the short term waves.
CO6:	Solve wave parameters of the long term waves.
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.
REFERENCES:	
1	Ippen, A.T., "Estuary and Coastline Hydrodynamics", McGraw-Hill Book Company, inc., New York, 1978.
2	"Coastal Engineering Manual Volume I and II", Coastal Engineering Research Centre, Dept, of the Army, US Army Corps of Engineers, Washington DC, 2006.
3	Sorenson, R.M., "Basic Coastal Engineering", A Wiley-Inter science Publication, New York, 1978.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	2	1	1	1	1	2	2	1	1
2	2	1	-	-	1	2	1	2	1	1	2	2	2	1	2
3	2	1	-	-	2	2	1	2	1	1	2	2	2	2	2
4	2	1	-	-	3	2	1	2	1	2	2	2	2	3	2
5	3	2	1	1	3	2	1	2	2	1	2	2	3	3	2
6	3	2	1	1	3	2	1	2	2	1	2	2	3	3	2
Overall Correlation	3	2	1	1	3	2	1	2	2	2	2	2	3	3	2

23CE074	MARINE GEOTECHNICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE 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

Marine environment, Physical and engineering properties of marine soils - Specific problems related to marine soil deposits.

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 near shore foundations, Gravity platforms, Jack-up rigs, pile foundations, Caissons, spudcan.

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

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline the physical and engineering properties of marine soil deposits.
CO2:	Explain the site investigation techniques used for marine soil deposits.
CO3:	Illustrate the effect of wave loading on engineering properties of marine soil deposits.
CO4:	Explain the foundation adopted in marine soil deposits.
CO5:	Illustrate suitable marine foundation as per project requirement.
CO6:	Model and design marine foundation subjected to wave loading.
TEXT 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.
REFERENCES:	
1	D. Thomson and D. J. Beasley, "Handbook of Marine Geotechnical Engineering", US Navy, 2012.
2	Joy Molel, "Marine Geotechnical Engineering", Pearson, 2020.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	2	2	2	1	2	2	2	2	2
2	2	1	-	-	1	2	1	1	1	1	2	2	2	1	1
3	2	1	-	-	1	2	1	1	1	1	2	2	2	1	1
4	2	1	-	-	1	2	1	1	2	2	1	2	2	1	1
5	2	1	-	-	1	1	1	2	2	1	2	1	2	1	2
6	3	2	1	1	2	1	1	1	2	1	1	2	3	2	1
Overall Correlation	3	2	1	1	2	2	2	2	2	2	2	2	3	2	2

23CE075	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE 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

Beaches - Coastal features - Coastal Zonation - EEZ -Inshore and Offshore Areas - Mean Sea level - Basics of Tides and Waves - Coastal Morphology.

UNIT II	WAVE 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, Bio shields - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline the basic concepts of coastal environment.
CO2:	Compare sea state parameters in shallow and deep water conditions.
CO3:	Explain the principles of near shore wave transformation.
CO4:	Explain the sediment and its transport processes.
CO5:	Explain shore protection structures.
CO6:	Explain the measures to protect beaches from erosion due to waves and currents.
TEXT BOOKS:	
1	Kamphuis, J.W., "Introduction to coastal engineering and management", 2000.
2	Mani J.S, "Coastal Engineering book", PHI Publishing Company, 2^{nd} Edition, 2021.
REFERENCES:	
1	Dean, R.G. and Dalrymple, R.A., "Water wave mechanics for Engineers and Scientists", Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1994.
2	Ippen, A.T., "Estuary and Coastline Hydrodynamics", McGraw-Hill Book Company, Inc., New York, 1978.
3	Sorenson, R.M., "Basic Coastal Engineering", A Wiley-Inter science Publication, New York, 1978.
4	Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC,2006.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	2	1	1	2	1	2	2	1	1
2	2	1	-	-	1	1	1	2	1	2	1	2	2	1	3
3	2	1	-	-	2	2	1	2	1	2	1	2	2	2	2
4	2	1	-	-	3	2	1	2	1	1	1	2	2	3	3
5	2	1	-	-	3	2	1	2	1	2	1	2	2	3	3
6	2	1	-	-	3	2	1	2	1	2	1	2	2	3	3
Overall Correlation	2	1	-	-	3	2	2	2	1	2	1	2	2	3	3

23CE076	PORT AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
The purpose of this course is to impart the concepts of port and harbour planning, design, implementation and maintenance.					
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
COURSE OUTCOMES:					
After completion of the course, the students will be able to:					

CO1:	Classify port and harbor and the data requirement and measurements for port and harbour structures.
CO2:	Outline the layout operations for vessel navigation and cargo handling.
CO3:	Explain the design guidelines for port structure.
CO4:	Explain the design guidelines for harbour structure.
CO5:	Summarize the construction, maintenance and renovation aspects of ports.
CO6:	Explain the concept of Smart Port and Smart application for ports.
TEXT BOOKS:	
1	Bruun, Per. "Port engineering: vol. 1. Harbor planning, breakwaters, and marine terminals", 1989.
2	D. Quinn, "Design and Construction of Port and Marine Structures", McGraw-Hill Book Company, 2nd Edition, 1972.
REFERENCES:	
1	C. A. Thoresen, "Port Design- Guidelines and recommendations", Tapir Publications, Edition 1, 1988.
2	J. W. Gaythwaite, Van Nostrand , "Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels," 1990.
3	Muir Wood, A.M., and Fleming. C.A., "Coastal Hydraulics Sea and Inland Port Structures", 1st Edition, Hallstead Press, 2002.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	1	2	1	2	1	1
2	2	1	-	-	1	1	1	1	1	1	1	1	2	1	1
3	2	1	-	-	2	2	2	2	1	2	1	1	2	2	2
4	2	1	-	-	2	2	2	2	1	2	1	1	2	2	2
5	2	1	-	-	2	1	1	1	2	2	2	1	2	2	1
6	2	1	-	-	2	1	1	1	2	2	2	1	2	2	1
Overall Correlation	2	1	-	-	2	2	2	2	2	2	2	1	2	2	2

23CE077	COASTAL HAZARDS AND MITIGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students understanding of the materials and processes associated with the major natural hazards: floods, earthquakes, tsunamis, landslides and other coastal hazards
- To be able to mitigate these hazards based on case studies and respond in the event of a disaster by appropriate strategies.

UNIT I	INTRODUCTION	9

Introduction to Environmental and Human induced hazards - Natural vs. Man-made hazard - Hazard and disaster, vulnerability, resilience - Coping mechanisms.

UNIT II	COASTAL HAZARDS	9

Coastal hazards- Tsunami, Cyclones, Earthquakes, Storm surges, Coastal erosion, Floods, Sea Level Rise –Technological Hazards – Causes – Impacts – Responses – mitigation strategies - Early warning systems.

UNIT III	LAW AND POLICY	9

Disaster management law and policy in India – Changing pattern of disaster management in India – Response and recovery framework - Enabling institutions– institutional coordination.

UNIT IV	ADAPTATION AND MITIGATION	9

Coastal Hazards Adaptation Strategy - Adaptation indigenous knowledge - Sectoral adaptations - Disaster risk response frameworks - Mapping and planning for disaster -Community based disaster Mitigation Measures – Indigenous knowledge for disaster Mitigation - NDMA guidelines.

UNIT V	**CASE STUDIES** — **9**
Case studies of tsunami (2004 Indian Ocean tsunami), Earthquake (Latur), cyclones (Gaja,2018 Tamilnadu), other cyclones, coastal erosion, oil spills, chemical disasters, nuclear disasters – vulnerability of coastal megacities - lessons from building back better.	
	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Outline the concepts of coastal hazards and their physical process.
CO2:	Classify the coastal hazards.
CO3:	Explain the various laws and policies involved in disaster management.
CO4:	Summarize the adaptation strategy and mitigation measure to coastal hazards.
CO5:	Relate the coastal hazards based on case studies.
CO6:	Outline the disaster by appropriate strategies.
TEXT BOOKS:	
1	Bryant, E., "Natural Hazards", Cambridge University Press, New York, 2006.
2	Rajib Shaw and RR Krishnamurthy, "Disaster Management: Global Challenges Local Solutions" University Press, 2009.
REFERENCES:	
1	National Disaster Management Agency – "Guidelines issued by NDMA such as for earthquakes, tsunamis, cyclones, chemical disasters etc", www.ndma.gov.in.
2	National Disaster Management Division, Ministry of Home Affairs, GoI. http://www.ndmindia.nic.in/ Regularly issued guidelines and training materials especially for disaster management policy, reconstruction of buildings etc.
3	United Nations office for Disaster Risk Reduction www.unisdr.org various publications and guidelines that

	are constantly updated.
4	Asia Disaster Preparedness Centre, "Publications specific to disaster preparedness and response in Asia". www.adpc.net.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	1	1	1	2	2	1	1
2	2	1	-	-	1	1	1	2	1	2	1	1	2	1	2
3	2	1	-	-	3	2	1	2	2	2	2	2	2	3	2
4	2	1	-	-	1	2	2	1	2	2	2	2	2	1	1
5	2	1	-	-	2	2	2	2	1	2	2	1	2	2	2
6	2	1	-	-	2	2	2	2	1	2	2	1	2	2	2
Overall Correlation	2	1	-	-	2	2	2	2	2	2	2	2	2	2	2

23CE078	OFFSHORE STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:		
Students mainly focused in understanding the offshore environment, types, suitability, and design concepts of offshore structures as per the appropriate requirements.		
UNIT I	**INTRODUCTION TO OFFSHORE ENVIRONMENT**	**9**
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.		
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 STRUTURES**	**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
COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Outline the offshore environment and technical terms associated with it.
CO2:	Explain the types and choose suitable offshore structures according to environmental conditions.
CO3:	Identify various types of forces acting on the offshore structures
CO4:	Make use of appropriate codes to design the submarine pipelines.
CO5:	Explain about the accidental loads.
CO6:	Outline the corrosion on offshore structures.
TEXT BOOKS:	
1	Graff, W. J., "Introduction to Offshore Structures", Gulf Publ. Co.1981.
2	Dawson, T. H., "Offshore Structural Engineering", Prentice Hall, 1983
REFERENCES:	
1	B.C Gerwick, Jr., "Construction of Marine and Offshore Structures", CRC Press, Florida, 2000.
2	Clauss, G, Lehmann, E & Ostergaard, C, "Offshore Structures", Vol. 1 & 2, Springer-Verlag, 1992.
3	Reddy, D. V and Arockiasamy, M., "Offshore Structures Vol.1 & 2", R.E Kreiger Publishing Company, 1991.
4	Morgan, N., "Marine Technology" Reference Book, Butterworths, 1990.
5	McClelland, B and Reifel, M. D., "Planning and Design of fixed Offshore Platforms", Van Nostrand, 1986.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	2	2	1	2	1	1	2	2	1	1
2	2	1	-	-	1	2	2	1	2	1	2	2	2	1	1
3	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2
4	3	2	1	1	3	2	2	2	2	2	2	2	3	3	2
5	2	1	-	-	2	2	2	1	2	1	1	2	2	2	1
6	2	1	-	-	2	2	2	1	2	1	1	2	2	2	1
Overall Correlation	3	2	1	1	2	2	2	2	2	1	2	2	3	2	2