GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

Curriculum For

B. E. Civil Engineering

(Full Time)

2022

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
THADAGAM ROAD, COIMBATORE - 641 013
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VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind**.**

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.

VISION AND MISSION OF THE DEPARTMENT

VISION

To provide quality education in Civil Engineering to the societal growth in sustainable manner on par with global standards

MISSION

* To establish the process of teaching and learning to meet the global standards for sustainable built environment
* To make Civil Engineering department a renowned high-tech consultancy centre.
* To carry out socially relevant and forward looking research for societal needs.
* Integrated with opportunities for teamwork, leadership, values, ethics and social activities.

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PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission

PEO 1: To produce competent Engineers to achieve a high level of technical expertise for the development of sustainable infrastructure

PEO 2: To prepare the graduates to be a part of an organization or entrepreneur or researcher for adopting towards emerging technologies.

PEO 3: To inculcate among the students the sense of ethics, moral values, professionalism and leadership with social concern.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will be able to design and execute various buildings and infrastructure projects in a sustainable manner

PSO2: Graduates will be able to excel in their professional career and development in research and innovation.

PSO3: Graduates will be able to give solution for the complex Civil Engineering problems with professional ethics, leadership and good communication capabilities.

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E. CIVIL ENGINEERING (FULL TIME)

FIRST SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
	22CMC1Z0	Induction Programme	MC	--	--	--	--	--	--	0
1	22CHS1Z1	தமிழர்மரபுHeritage of Tamils	HSMC	40	60	100	1	0	0	1
2	22CHS1Z2	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22CBS1Z1	Linear Algebra and Calculus	BS	40	60	100	3	1	0	4
4	22CBS1Z2	Engineering Physics	BS	40	60	100	3	0	0	3
5	22CBS103	Engineering Chemistry	BS	40	60	100	3	0	0	3
6	22CES101	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
PRACTICAL										
7	22CHS1Z3	Cambridge English	HSMC	100	--	100	0	0	2	1
8	22CBS1Z4	Chemistry Laboratory	BS	60	40	100	0	0	3	1.5
9	22CES1Z2	Engineering Graphics	ES	60	40	100	1	0	4	3
TOTAL				**460**	**440**	**900**	**17**	**1**	**9**	**22.5**

SECOND SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CHS2Z4	தமிழரும் தொழில்நுட்பமும்Tamils and Technology	HSMC	40	60	100	1	0	0	1
2	22CHS2Z5	Professional English	HS	40	60	100	2	1	0	3
3	22CBS205	Differential Equations and Numerical methods	BS	40	60	100	3	1	0	4
4	22CES203	Engineering Mechanics	ES	40	60	100	3	0	0	3
5	22CES204	Programming in C	ES	40	60	100	3	0	0	3
6	22CMC2Z1	Environmental Science and Engineering	MC	40	60	100	3	0	0	0
	22CNC201	NCC Credit Courses Level - I (Optional)		100	-	100	3	0	0	3
PRACTICAL										
7	22CBS2Z6	Physics Laboratory	BS	60	40	100	0	0	3	1.5
8	22CES2Z5	Workshop Practice	ES	60	40	100	0	0	3	1.5
9	22CES206	Programming in C Laboratory	ES	60	40	100	0	0	3	1.5
TOTAL				**420**	**480**	**900**	**15**	**2**	**9**	**18.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E. CIVIL ENGINEERING (FULL TIME)
2022 REGULATIONS

THIRD SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CBS307	Transform Calculus and Partial Differential Equations (*Common to Civil & IBT*)	BS	40	60	100	3	1	0	4
2	22CES307	Mechanics of Fluids	ES	40	60	100	3	0	0	3
3	22CES308	Engineering Geology	ES	40	60	100	3	0	0	3
4	22CPC301	Mechanics of Solids I	PC	40	60	100	3	0	0	3
5	22CPC303	Surveying	PC	40	60	100	3	0	0	3
THEORY WITH PRACTICAL COMPONENT										
6	22CPC302	Construction Materials and Technology	PC	50	50	100	2	0	2	3
PRACTICAL										
7	22CES309	Materials Testing Laboratory	ES	60	40	100	0	0	3	1.5
8	22CPC304	Survey Laboratory	PC	60	40	100	0	0	3	1.5
	TOTAL			**370**	**430**	**800**	**17**	**1**	**8**	**22**

FOURTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CES410	Applied Hydraulics and Fluid Machinery	ES	40	60	100	3	0	0	3
2	22CPC405	Mechanics of Solids II	PC	40	60	100	3	0	0	3
3	22CPC406	Concrete Technology	PC	40	60	100	3	0	0	3
4	22CPC407	Design of Reinforced Concrete Elements	PC	40	60	100	3	0	0	3
5	22CPC408	Water Supply Engineering	PC	40	60	100	3	0	0	3
6	22CMC4Z2	Constitution of India (Common to all branches)	MC	40	60	100	3	0	0	0
PRACTICAL										
7	22CES411	Fluid Mechanics and Machinery Laboratory	ES	60	40	100	0	0	3	1.5
8	22CES412	Engineering Exploration for Civil Engineering	ES	100	-	100	0	0	3	1.5
9	22CPC409	Environmental Engineering Laboratory	PC	60	40	100	0	0	3	1.5
	TOTAL			**460**	**440**	**900**	**18**	**0**	**9**	**19.5**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E. CIVIL ENGINEERING (FULL TIME)

2022 REGULATIONS

FIFTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CPC510	Structural Analysis I	PC	40	60	100	3	0	0	3
2	22CPC511	Design of Steel Structures	PC	40	60	100	3	0	0	3
3	22CPC512	Wastewater Engineering	PC	40	60	100	3	0	0	3
4	22CPC513	Highway and Railway Engineering	PC	40	60	100	3	0	0	3
5	22CPC514	Mechanics of Soils	PC	40	60	100	3	1	0	4
6	22CPE$XX	Professional Elective I	PE	40	60	100	3	0	0	3
PRACTICAL										
7	22CPC515	Geotechnical Engineering Laboratory	PC	60	40	100	0	0	3	1.5
8	22CEE501	Concrete and Structural Analysis Laboratory	EEC	60	40	100	0	0	3	1.5
	TOTAL			**360**	**440**	**800**	**18**	**1**	**6**	**22**

SIXTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CPC616	Structural Analysis II	PC	40	60	100	3	0	0	3
2	22CPC617	Design of Concrete Structures	PC	40	60	100	3	0	0	3
3	22CPC618	Water Resources Engineering	PC	40	60	100	3	0	0	3
4	22CPC619	Foundation Engineering	PC	40	60	100	3	1	0	4
5	22CPE$XX	Professional Elective II	PE	40	60	100	3	0	0	3
6	22#OE$XX	Open Elective I/ Professional Elective VII	OE/PE	40	60	100	3	0	0	3
PRACTICAL										
7	22CPC620	Transportation Engineering Laboratory	PC	60	40	100	0	0	3	1.5
8	22CEE602	Computer Aided Civil Engineering Drawing	EEC	60	40	100	0	0	3	1.5
9	22CES613	Design Thinking for Civil Engineering	ES	100	-	100	0	0	3	1.5
	TOTAL			**460**	**440**	**900**	**18**	**1**	**9**	**23.5**

SEVENTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CHS706	Construction Engineering and Management	HSMC	40	60	100	3	0	0	3
2	22CPC721	Estimation, Costing and Valuation	PC	40	60	100	3	0	0	3
3	22CPC722	Prestressed and Precast Concrete Structures	PC	40	60	100	3	0	0	3
4	22CPE$XX	Professional Elective III	PE	40	60	100	3	0	0	3
5	22CPE$XX	Professional Elective IV	PE	40	60	100	3	0	0	3
6	22#OE$XX	Open Elective II / Professional Elective VIII	OE/PE	40	60	100	3	0	0	3
PRACTICAL										
7	22CPC723	Software Application Laboratory	PC	60	40	100	0	0	4	2
8	22CEE704	Analysis and Design using Software Laboratory	EEC	60	40	100	0	0	2	1
9	22CEE705	Engineering Projects In Community Service	EEC	60	40	100	0	0	4	2
10	22CEE706	Internship *	EEC	100	--	100				4
	TOTAL			**520**	**480**	**1000**	**18**	**0**	**12**	**27**

EIGHTH SEMESTER

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
THEORY										
1	22CPE$XX	Professional Elective V	PE	40	60	100	3	0	0	3
2	22CPE$XX	Professional Elective VI	PE	40	60	100	3	0	0	3
PRACTICAL										
3	22CEE807	Capstone Project	EEC	60	40	100	0	0	16	8
	TOTAL			**140**	**160**	**300**	**6**	**0**	**16**	**14**

Note:

***Internship of four consecutive weeks or two 2 consecutive weeks which are completed during the vacation of fourth (and/or) fifth (and/or) sixth semester shall be considered here.**

Total Credits: 169

CATEGORY – WISE CREDIT DISTRIBUTION

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT (HS/HSMC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CHS1Z1	தமிழர் மரபு Heritage of Tamils	HSMC	40	60	100	1	0	0	1
2	22CHS1Z2	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22CHS1Z3	Cambridge English	HSMC	60	40	100	0	0	2	1
4	22CHS2Z4	தமிழரும் தொழில் நுட்பமும் Tamils and Technology	HSMC	40	60	100	1	0	0	1
5	22CHS2Z5	Professional English	HS	40	60	100	2	1	0	3
6	22CHS706	Construction Engineering and Management	HSMC	40	60	100	3	0	0	3

BASIC SCIENCE (BS)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CBS1Z1	Linear Algebra and Calculus	BS	40	60	100	3	1	0	4
2	22CBS1Z2	Engineering Physics	BS	40	60	100	3	0	0	3
3	22CBS103	Engineering Chemistry	BS	40	60	100	3	0	0	3
4	22CBS1Z4	Chemistry Laboratory	BS	60	40	100	0	0	3	1.5
5	22CBS205	Differential Equations and Numerical methods	BS	40	60	100	3	1	0	4
6	22CBS2Z6	Physics Laboratory	BS	60	40	100	0	0	3	1.5
7	22CBS307	Transform Calculus and Partial Differential Equations (Common to Civil & IBT)	BS	40	60	100	3	1	0	4

ENGINEERING SCIENCE (ES)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CES101	Basics of Electrical and Electronics Engineering	ES	40	60	100	3	0	0	3
2	22CES1Z2	Engineering Graphics	ES	60	40	100	1	0	4	3
3	22CES203	Engineering Mechanics	ES	40	60	100	3	0	0	3
4	22CES204	Programming in C	ES	40	60	100	3	0	0	3
5	22CES2Z5	Workshop Practice	ES	60	40	100	0	0	3	1.5
6	22CES206	Programming in C Laboratory	ES	60	40	100	0	0	3	1.5
7	22CES307	Mechanics of Fluids	ES	40	60	100	3	0	0	3
8	22CES308	Engineering Geology	ES	40	60	100	3	0	0	3
9	22CES309	Materials Testing Laboratory	ES	60	40	100	0	0	3	1.5
10	22CES410	Applied Hydraulics and Fluid Machinery	ES	50	50	100	3	0	0	3
11	22CES411	Fluid Mechanics and MachineryLaboratory	ES	60	40	100	0	0	3	1.5
12	22CES412	Engineering Exploration for Civil Engineering	ES	100	-	100	0	0	3	1.5
13	22CES613	Design Thinking for Civil Engineering	ES	100	-	100	0	0	3	1.5

PROFESSIONAL CORE (PC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CPC301	Mechanics of Solids I	PC	40	60	100	3	0	0	3
2	22CPC302	Construction Materials and Technology	PC	40	60	100	2	0	2	3
3	22CPC303	Surveying	PC	50	50	100	3	0	0	3
4	22CPC304	Survey Laboratory	PC	60	40	100	0	0	3	1.5
5	22CPC405	Mechanics of Solids II	PC	40	60	100	3	0	0	3
6	22CPC406	Concrete Technology	PC	40	60	100	3	0	0	3
7	22CPC407	Design of Reinforced Concrete Elements	PC	40	60	100	3	0	0	3
8	22CPC408	Water Supply Engineering	PC	40	60	100	3	0	0	3
9	22CPC409	Environmental Engineering Laboratory	PC	60	40	100	0	0	3	1.5
10	22CPC510	Structural Analysis I	PC	40	60	100	3	0	0	3
11	22CPC511	Design of Steel Structures	PC	40	60	100	3	0	0	3
12	22CPC512	Wastewater Engineering	PC	40	60	100	3	0	0	3
13	22CPC513	Highway and Railway Engineering	PC	40	60	100	3	0	0	3
14	22CPC514	Mechanics of Soils	PC	40	60	100	3	1	0	4
15	22CPC515	Geotechnical Engineering Laboratory	PC	60	40	100	0	0	3	1.5
16	22CPC616	Structural Analysis II	PC	40	60	100	3	0	0	3
17	22CPC617	Design of Concrete Structures	PC	40	60	100	3	0	0	3
18	22CPC618	Water Resources Engineering	PC	40	60	100	3	0	0	3
19	22CPC619	Foundation Engineering	PC	40	60	100	3	1	0	4
20	22CPC620	Transportation Engineering Laboratory	PC	60	40	100	0	0	3	1.5
21	22CPC721	Estimation, Costing and Valuation	PC	40	60	100	3	0	0	3
22	22CPC722	Prestressed Concrete Structures	PC	40	60	100	3	0	0	3
23	22CPC723	Software Application Laboratory	PC	60	40	100	1	0	2	2

PROFESSIONAL ELECTIVE (PE)

Verticals for B. E. Degree (Honours) with Specialization

Vertical I	Vertical II	Vertical III	Vertical IV
Structural Engineering	**Environmental Engineering**	**Geotechnical Engineering**	**Infrastructure Engineering**
22CPE$01 Smart Materials and Smart Structures	22CPE$10 Design and Detailing of Irrigation and Environmental Structures	22CPE$20 Ground Improvement Techniques	22CPE$29 Quality Control and Assurance in Construction
22CPE$02 Experimental Stress Analysis	22CPE$11 Environmental Legislations in India	22CPE$21 Slope Stability and Landslides	22CPE$30 Energy Conservation Techniques in Construction
22CPE$03 Finite Element Method	22CPE$12 Industrial Wastewater Management	22CPE$22 Earth Retaining Structures	22CPE$31 Pavement Engineering
22CPE$04 Advanced Concrete Design	22CPE$13 Sustainable Engineering and Technology	22CPE$23 Foundations in Expansive Soils	22CPE$32 Airport, Docks and Harbour Engineering
22CPE$05 Basics of Dynamics and Aseismic Design of Structures	22CPE$14 Fundamentals of Remote Sensing and GIS Applications	22CPE$24 Land Reclamation	22CPE$33 Highways – State of Art
22CPE$06 Design and Detailing of Concrete and Steel Structures	22CPE$15 Irrigation Engineering and Hydraulic Structures	22CPE$25 Environmental Geotechnology	22CPE$34 Traffic Engineering and Management
22CPE$07 Bridge Engineering	22CPE$16 Hydrology	22CPE$26 Reinforced Soil Structures	22CPE$35 Town Planning and Architecture
22CPE$08 Earthquake Engineering	22CPE$17 Environmental Management	22CPE$27 Design of Underground Excavations	22CPE$36 IOT Platform for smart city planning
22CPE$09 Maintenance and Rehabilitation of Structures	22CPE$18 Air Pollution Management	22CPE$28 Geotechniques for infrastructure	22CPE$37 Intelligent Building Techniques
-	22CPE$19 Integrated Urban Water Management	-	22CPE$38 GIS implementation in smart city development
-	-	-	22CPE$39 Robotics and Automation
-	-	-	22CPE$40 Road Safety Engineering

Vertical I: Structural Engineering

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CPE$01	Smart Materials and Smart Structures	PE	40	60	100	3	0	0	3
2	22CPE$02	Experimental Stress Analysis	PE	40	60	100	3	0	0	3
3	22CPE$03	Finite Element Method	PE	40	60	100	3	0	0	3
4	22CPE$04	Advanced Concrete Design	PE	40	60	100	3	0	0	3
5	22CPE$05	Basics of Dynamics and Aseismic Design of Structures	PE	40	60	100	3	0	0	3
6	22CPE$06	Design and Detailing of Concrete and Steel Structures	PE	40	60	100	3	0	0	3
7	22CPE$07	Bridge Engineering	PE	40	60	100	3	0	0	3
8	22CPE$08	Earthquake Engineering	PE	40	60	100	3	0	0	3
9	22CPE$09	Maintenance and Rehabilitation of Structures	PE	40	60	100	3	0	0	3

Vertical II: Environmental Engineering

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CPE$10	Design and Detailing of Irrigation and Environmental Structures	PE	40	60	100	3	0	0	3
2	22CPE$11	Environmental Legislations in India	PE	40	60	100	3	0	0	3
3	22CPE$12	Industrial Wastewater Management	PE	40	60	100	3	0	0	3
4	22CPE$13	Sustainable Engineering and Technology	PE	40	60	100	3	0	0	3
5	22CPE$14	Fundamentals of Remote Sensing and GIS Applications	PE	40	60	100	3	0	0	3
6	22CPE$15	Irrigation Engineering and Hydraulic Structures	PE	40	60	100	3	0	0	3
7	22CPE$16	Hydrology	PE	40	60	100	3	0	0	3
8	22CPE$17	Environmental Management	PE	40	60	100	3	0	0	3
9	22CPE$18	Air Pollution Management	PE	40	60	100	3	0	0	3
10	22CPE$19	Integrated Urban Water Management	PE	40	60	100	3	0	0	3

Vertical III: Geotechnical Engineering

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CPE$20	Ground Improvement Techniques	PE	40	60	100	3	0	0	3
2	22CPE$21	Slope Stability and Landslides	PE	40	60	100	3	0	0	3
3	22CPE$22	Earth Retaining Structures	PE	40	60	100	3	0	0	3
4	22CPE$23	Foundations in Expansive Soils	PE	40	60	100	3	0	0	3
5	22CPE$24	Land Reclamation	PE	40	60	100	3	0	0	3
6	22CPE$25	Environmental Geotechnology	PE	40	60	100	3	0	0	3
7	22CPE$26	Reinforced Soil Structures	PE	40	60	100	3	0	0	3
8	22CPE$27	Design of Underground Excavations	PE	40	60	100	3	0	0	3
9	22CPE$28	Geotechniques for infrastructure	PE	40	60	100	3	0	0	3

Vertical IV: Infrastructure Engineering

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CPE$29	Quality Control and Assurance in Construction	PE	40	60	100	3	0	0	3
2	22CPE$30	Energy Conservation Techniques in Construction	PE	40	60	100	3	0	0	3
3	22CPE$31	Pavement Engineering	PE	40	60	100	3	0	0	3
4	22CPE$32	Airport, Docks and Harbour Engineering	PE	40	60	100	3	0	0	3
5	22CPE$33	Highways – State of Art	PE	40	60	100	3	0	0	3
6	22CPE$34	Traffic Engineering and Management	PE	40	60	100	3	0	0	3
7	22CPE$35	Town Planning and Architecture	PE	40	60	100	3	0	0	3
8	22CPE$36	IOT Platform for smart city planning	PE	40	60	100	3	0	0	3
9	22CPE$37	Intelligent Building Techniques	PE	40	60	100	3	0	0	3
10	22CPE$38	GIS implementation in smart city development	PE	40	60	100	3	0	0	3
11	22CPE$39	Robotics and Automation	PE	40	60	100	3	0	0	3
12.	22CPE$40	Road Safety Engineering	PE	40	60	100	3	0	0	3

Vertical for B.E. / B.Tech. with Minor Degree

Vertical I
Sustainability in Civil Engineering
22CPE$38 GIS implementation in smart city development
22CPE$41 IoT in Construction
22CPE$42 Sustainable Infrastructure Development
22CPE$43 Sustainable Environmental Management
22CPE$44 Materials for Energy Sustainability
22CPE$45 Green Technology
22CPE$46 Building Information Modeling Systems
22CPE$47 Modern Construction Equipments

Vertical I: Sustainability in Civil Engineering

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22CPE$38	GIS implementation in smart city development	PE	40	60	100	3	0	0	3
2.	22CPE$41	IoT in Construction	PE	40	60	100	3	0	0	3
3.	22CPE$42	Sustainable Infrastructure Development	PE	40	60	100	3	0	0	3
4.	22CPE$43	Sustainable Environmental Management	PE	40	60	100	3	0	0	3
5.	22CPE$44	Materials for Energy Sustainability	PE	40	60	100	3	0	0	3
6.	22CPE$45	Green Technology	PE	40	60	100	3	0	0	3
7.	22CPE$46	Building Information Modeling Systems	PE	40	60	100	3	0	0	3
8.	22CPE$47	Modern Construction Equipments	PE	40	60	100	3	0	0	3

OPEN ELECTIVES (OE)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	22COE$01	Disaster Management and Mitigation	OE	40	60	100	3	0	0	3
2.	22COE$02	Water Sanitation and Health	OE	40	60	100	3	0	0	3
3.	22MOE$03	Nanotechnology and Surface Engineering	OE	40	60	100	3	0	0	3
4.	22MOE$04	Industrial Safety Management	OE	40	60	100	3	0	0	3
5.	22EOE$05	Renewable Power Generation Systems	OE	40	60	100	3	0	0	3
6.	22EOE$06	Smart Grid Technology	OE	40	60	100	3	0	0	3
7.	22LOE$07	CMOS VLSI Design	OE	40	60	100	3	0	0	3
8.	22LOE$08	Mobile Communication	OE	40	60	100	3	0	0	3
9.	22POE$09	Rapid Prototyping	OE	40	60	100	3	0	0	3
10	22POE$10	Managerial Economics	OE	40	60	100	3	0	0	3
11.	22NOE$11	Measurement and Control	OE	40	60	100	3	0	0	3
12.	22NOE$12	Industrial Automation	OE	40	60	100	3	0	0	3
13.	22SOE$13	Programming in Java	OE	40	60	100	3	0	0	3
14.	22SOE$14	Network Essential	OE	40	60	100	3	0	0	3
15.	22I0E$15	Video creation and editing	OE	40	60	100	3	0	0	3
16.	22IOE$16	Digital marketing	OE	40	60	100	3	0	0	3
17.	22BOE$17	Principles Of Food Technology	OE	40	60	100	3	0	0	3
18.	22BOE$18	Biology For Engineers	OE	40	60	100	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CEE501	Concrete and Structural Analysis Laboratory	EEC	60	40	100	0	0	3	1.5
2	22CEE602	Computer Aided Civil Engineering Drawing	EEC	60	40	100	0	0	3	1.5
3	22CEE704	Analysis and Design using Software Laboratory	EEC	60	40	100	0	0	2	1
4	22CEE705	Engineering Projects In Community Service	EEC	60	40	100	0	0	4	2
5	22CEE706	Internship	EEC	100	--	100				4
6	22CEE807	Capstone Project	EEC	60	40	100	0	0	16	8

MANDATORY COURSE (MC) (NO - CREDIT)

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CMC1Z0	Induction Programme (3 weeks)	MC	--	--	--	-	-	-	0
2	22CMC2Z1	Environmental Science and Engineering	MC	40	60	100	3	0	0	0
3	22CMC4Z2	Constitution of India	MC	40	60	100	3	0	0	0

LIST OF VALUE ADDED COURSES

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22CVA$07	Recent trends in design and detailing of structures	EEC	100	--	100	1	0	0	1
2	22CVA$08	Emerging Construction Technologies for Housing	EEC	100	--	100	1	0	0	1
3	22CVA$09	Building modelling using 3D Revit architecture	EEC	100	--	100	1	0	0	1
4	22CVA$10	Building plan with Bye – Laws	EEC	100	--	100	1	0	0	1
5	22CVA$11	Environmental Impact Assessment	EEC	100	--	100	2	0	0	2
6	22CVA$12	Software Applications for Project Management	EEC	100	--	100	1	0	0	1
7	22CVA$13	3D Printing Technology for Civil Engineering	EEC	100	--	100	1	0	0	1
8	22CVA$14	Comprehensive Viva - Civil Engineering	EEC	100	--	100	1	0	0	1
9	22CVA$15	Professional Skills and Career Readiness	EEC	100	--	100	1	0	0	1
10	22CVA$16	Placement Training	EEC	100	--	100	1	0	0	1

SUMMARY OF CREDIT DISTRIBUTION

B.E. CIVIL ENGINEERING

Sl. No	Course Category	Credits per Semester									Total credits	Total credits in %
		I	II	III	IV	V	VI	VII	VIII	Internship#		
1	HS/HSMC	5.0	4.0	-	-	-	-	3.0	-	-	12	7.0
2	BS	11.5	5.5	4.0	-	-	-	-	-	-	21	12.4
3	ES	6.0	9.0	7.5	6.0	-	1.5	-	-	-	30	17.6
4	PC	-	-	10.5	13.5	17.5	14.5	8.0	-	-	64	37.6
5	PE	-	-	-	-	3.0	3.0	6.0	6.0	-	18	10.6
6	OE	-	-	-	-	-	3.0	3.0	-	-	06	3.5
7	EEC	-	-	-	-	1.5	1.5	3.0	8.0	4.0	18	11.2
8	MC	0	0	-	0	-	-	-	-	-	0	0
	Total	**22.5**	**18.5**	**22**	**19.5**	**22**	**23.5**	**27**	**14**	**4.0**	**169**	**100**

Schedule of Courses

SEM	Theory						Practical				Mandatory	Credits
	1	2	3	4	5	6	7	8	9	10	11	
I	22CHS1Z1 தமிழர் மரபு Heritage of Tamils(1)	22CHS1Z2 Values and Ethics (3)	22CBS1Z1 Linear Algebra and Calculus (4)	22CBS1Z2 Engineering Physics (3)	22CBS103 Engineering Chemistry (3)	22CES101 Basics of Electrical and Electronics Engineering (3)	22CHS1Z3 Cambridge English (1)	22CBS1Z4 Chemistry Laboratory (1.5)	22CES1Z2 Engineering Graphics (3)	-	22CMC1Z0 Induction Programme	**22.5**
II	22CHS2Z4 தமிழரும் தொழில் நுட்பமும் Tamils and Technology(1)	22CHS2Z5 Professional English (3)	22CBS205 Differential Equations and Numerical methods (4)	22CES203 Engineering Mechanics (3)	22CES204 Programming in C (3)	-	22CBS2Z6 Physics Laboratory (1.5)	22CES2Z5 Workshop Practice (1.5)	22CES206 Programming in C Laboratory (1.5)	-	22CMC2Z1 Environmental Science and Engineering	**18.5**
III	22CBS307 Transform Calculus and Partial Differential Equations (4)	22CES307 Mechanics of Fluids (3)	22CES308 Engineering Geology (3)	22CPC301 Mechanics of Solids I (3)	22CPC302 Construction Materials and Technology (3)	22CPC303 Surveying (3)	22CES309 Materials Testing Laboratory (1.5)	22CPC304 Survey Laboratory (1.5)	-	-	-	**22**
IV	22CPC405 Mechanics of Solids II (3)	22CPC406 Concrete : Theory and Practice (3)	22CPC407 Water Supply Engineering (3)	22CPC408 Design of Reinforced Cement Concrete Elements (3)	22CES410 Applied Hydraulics and Fluid Machinery(3)	-	22CES512 Engineering Exploration (CDIO) (1.5)	22CES411Fluid Mechanics and Machinery Laboratory (1.5)	22CPC409 Environmental Engineering Laboratory (1.5)	-	22CMC4Z2 Constitution of India	**19.5**
V	22CPC510 Structural Analysis I (3)	22CPC511 Design of Steel Structures (3)	22CPC512 Wastewater Engineering (3)	22CPC513 Highway and Railway Engineering (3)	22CPC514 Mechanics of Soils (4)	22CPE$XX Professional Elective I (3)	22CEE501 Concrete and Structural Analysis Laboratory (1.5)	22CPC515 Geotechnical Engineering Laboratory (1.5)	-	-	22CMC5Z3 Engineering Projects in Community Services (0)	**22**
VI	22CPC616 Structural Analysis II (4)	22CPC617 Design of Concrete Structures (3)	22CPC618 Water Resources Engineering (3)	22CPC619 Foundation Engineering (3)	22CPE$XX Professional Elective II (3)	22#OE$XX Open Elective I / Professional Elective VII (3)	22CPC620 Transportation Engineering Laboratory (1.5)	22CEE602 Computer Aided Civil Engineering Drawing (1.5)	22CES613 Design Thinking for Civil Engineering (1.5)	-	-	**23.5**
VII	22CHS706 Construction Engineering and Management (3)	22CPC721 Estimation, Costing and Valuation (3)	22CPC722 Prestressed and Precast Concrete Structures (3)	22CPE$XX Professional Elective III (3)	22CPE$XX Professional Elective IV (3)	22#OE$XX Open Elective II / Professional Elective VIII (3)	22CPC723 Software Application Laboratory (2)	22CEE704 Analysis and Design using Software Laboratory (1)	22CEE705 Engineering Projects In Community Service (2)	22CEE706 Internship (4)	-	**27**
VIII	22CPE$XX Professional Elective V (3)	22CPE$XX Professional Elective VI (3)	-	-	-	-	22CEE807 Capstone Project (8)	-	-	-	-	**14**
											Total Credits	**169**

SYLLABUS

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore–641013.
CIVIL ENGINEERING

22CMC1Z0	INDUCTION PROGRAMME	SEMESTER I

Details of the Programme:

Day 0: College Admission

Day1: Orientation Programme

Day2: Onwards : Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary,
Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc.

22CHS1Z1	தமிழர் மரபு Heritage of Tamils (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

UNIT – I	**LANGUAGE AND LITERATURE**	**3 Periods**
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 Periods**
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 Periods**
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.		
UNIT – IV	**THINAI CONCEPT OF TAMILS**	**3 Periods**
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 Periods**
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.		
Contact Periods: **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**		

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies)
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22CHS1Z1	தமிழர் மரபு Heritage of Tamils (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	மொழி மற்றும் இலக்கியம்	3 Periods
இந்திய மொழிக் குடும்பங்கள்---திராவிட மொழிகள் தமிழ் ஒரு செம்மொழி தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை சங்க இலக்கியத்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்-தமிழ்க்காப்பியங்கள், தமிழகத்தில் சமண பௌத்தசமயங்களின் தாக்கம்-பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்-சிற்றிலக்கியங்கள்-தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி-தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.		
அலகு II	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை–சிற்பக் கலை	3 Periods
நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்-பொம்மைகள் – தேர்செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர சிலை – இசைக் கருவிகள் – மிருதங்கம் , பறை,வீணை, யாழ் , நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில்கோவில்களின் பங்கு.		
அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3 Periods
தெருக்கூத்து, கரகாட்டம் --- வில்லுப்பாட்டு கணியான் கூத்து ஒயிலாட்டம் தோல்பாவைக் கூத்து சிலம்பாட்டம் – வளரி புலியாட்டம் – தமிழர்களின் விளையாட்டுகள்.		
அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3 Periods
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு –சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –சங்ககால நகரங்களும் துறை முகங்களும்– சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.		
அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3 Periods
இந்திய விடுதலைபோரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள்-தமிழ்ப்புத்தகங்களின் அச்சு வரலாறு.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22CHS1Z2	**VALUES AND ETHICS** *(Common to all Branches)*	**SEMESTER I**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**HSMC**	**3**	**0**	**0**	**3**

Course Objectives	1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity. 2. To learn about Engineering Ethics and case studies. 3. To understand the negative health impacts of certain unhealthy behaviours. 4. To appreciate the need and importance of physical, emotional health and social health. 5. To get familiar with the global issues.	
UNIT – I	**BEING GOOD AND RESPONSIBLE**	**9 Periods**
Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence – Character.		
UNIT – II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9 Periods**
Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Models of Professional Roles. Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – Case studies: Chernobyl disaster and Titanic disaster.		
UNIT – III	**ADDICTION AND HEALTH**	**9 Periods**
Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases. Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention.		
UNIT – IV	**PROFESSIONAL ETHICS**	**9 Periods**
Abuse of Technologies**:** Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and social networking websites.		
UNIT – V	**GLOBAL ISSUES**	**9 Periods**
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Mike W Martin and Roland Schinzinger, **"Ethics in Engineering"**, 4th Edition, McGraw-Hill, New York 2017.*
2	*Govindarajan M, Natarajan S and Senthil Kumar VS, **"Engineering Ethics"**, Prentice Hall of India, New Delhi, 2013.*

REFERENCES:

1	*Dhaliwal, K.K,* ***"Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts",*** *Writers Choice, New Delhi, India, 2016.*
2	*Jayshree suresh, B.S.Raghavan,* ***"Human values and professional ethics"****, S.Chand & company Ltd, New Delhi, 2nd Edition, 2007.*
3	*L.A. and Pagliaro, A.M,* ***"Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological, Developmental and Clinical Considerations",*** *Wiley Publishers, U.S.A,2012.*
4	*Pandey, P. K (2012),* ***"Sexual Harassment and Law in India"****, Lambert Publishers, Germany, 2012.*
5	*Kiran D.R,* ***"Professional ethics and Human values",*** *Tata McGraw Hill, New Delhi, 2007.*
6	*Edmund G See Bauer and Robert L Barry,* ***"Fundamentals of Ethics for Scientists and Engineers"****, Oxford University Press, Oxford, 2001.*
7	*David Ermann and Michele S Shauf,* ***"Computers, Ethics and Society"****, Oxford University Press, 2003.*
8	*Govindarajan M, Natarajan S, Senthil Kumar V. S,* ***"Engineering Ethics"****, Prentice Hall of India, New Delhi, 2004.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Follow sound morals and ethical values scrupulously to prove as good citizens.	K3
CO2	Assess the relevance of ethics and morals in engineering and to learn case studies.	K3
CO3	Describe the concept of addiction and how it will affect the physical and mental health.	K2
CO4	Identify ethical concerns while using advanced technologies.	K2
CO5	Judge the code of conduct, Environmental ethics and computer ethics.	K3

COURSE ARTICULATION MATRIX :

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	3	3	3	3	3	3	-	-	1	-
CO2	-	-	-	-	-	3	1	3	3	-	-	-	-	2	1
CO3	-	-	-	-	-	3	1	3	3	2	3	-	-	1	-
CO4	-	-	-	-	-	3	3	3	3	1	3	1	-	2	1
CO5	-	-	-	-	-	3	3	3	3	-	1	3	-	1	1
22CHS1Z2	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**-**	2	1
	1 – Slight, 2 – Moderate, 3 – Substantial														

	b) CO and Key Performance Indicators Mapping
CO1	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1
CO2	6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1
CO3	6.1.1, 6.2.1, 7.1.1 ,8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2 , 9.2.3, 9.2.4, 9.3.1, 10.2.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1
CO4	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1
CO5	6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	20	20	--	--	100
CAT2	30	30	20	20	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	20	20	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	20	20	--	--	100
ESE	30	30	20	20	--	--	100

22CBS1Z1	LINEAR ALGEBRA AND CALCULUS *(Common to all Branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To acquire knowledge of system of equations, eigenvalues, eigenvectors, diagonalization of matrices and reduction of quadratic forms to canonical forms. 2. To obtain the knowledge of analyze the functions using Limits and derivative recognize the appropriate tools of differential calculus to solve applied problems. 3. To obtain the knowledge of definite and improper integration and recognize the appropriate tools of Integral Calculus to solve applied problems. 4. To develop the skills in solving the functions of several variables by partial derivatives. 5. To acquire knowledge of multiple integration and related applied problems in various geometry	
UNIT – I	**LINEAR ALGEBRA**	**9+3 Periods**
Consistency of System of Linear Equations - Eigen values and eigenvectors - Diagonalization of matrices by orthogonal transformation - Cayley-Hamilton Theorem - Quadratic to canonical forms.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9+3 Periods**
Limit and continuity of function - Rolle's theorem - Mean value theorems - Taylor's and Maclaurin's theorems. Application of Differential Calculus: Radius of curvature, Centre of curvature, Circle of curvature and Evolutes of a curve.		
UNIT – III	**INTEGRAL CALCULUS**	**9+3 Periods**
Evaluation of definite integral by trigonometric substitution - Convergence and Divergence of improper integrals - Beta & Gamma functions and their properties - Applications of definite integrals to evaluate surface areas and volume of revolution (Cartesian coordinates only).		
UNIT – IV	**PARTIAL DERIVATIVES AND ITS APPLICATIONS**	**9+3 Periods**
Partial derivatives - total derivative - Taylor's series – Jacobians - Maxima, minima and saddle points - Method of Lagrange multipliers.		
UNIT – V	**MULTI VARIABLE INTEGRAL CALCULUS**	**9+3 Periods**
Double integral - Area as double integral - change of order of integration in double integrals - Triple Integrals - Volume as Triple Integral. Change of variables: Cartesian to polar, Spherical polar coordinates, Cylindrical polar coordinates.		
Contact Periods : **Lecture: 45 Periods** **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan T., **"Engineering Mathematics I"**, Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi,2015.*
2	*David C.Lay, **"Linear Algebra and Its Application"**, Pearson Publishers, 6th Edition, 2021.*

REFERENCES

1	*B.S.Grewal, **"Higher Engineering Mathematics"**, Khanna Publishers, 44th Edition, 2017.*
2	*Howard Anton, **"Elementry Linear Algebra"**, 11thEdition, Wiley Publication, 2013.*
3	*Narayanan.S and Manicavachagom Pillai. T.K. – **"Calculas Vol I and Vol II"**, S.chand & Co, Sixth Edition, 2014.*
4	*H.K. Dass, **"Advance Engineering Mathematics"**, S. Chand and company, Eleventh Edition, 2015.*
5	*Jain R.K. and Iyengar S.R.K., **"Advanced Engineering Mathematics"**, Narosa Publicaitons, Eighth Edition, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Solve the linear system of equations, diagonalize matrix by orthogonal transformation and reduce quadratic form to canonical form.	K5
CO2	Compare and contrast the ideas of continuity and differentiability and use them to solve engineering problems.	K5
CO3	Acquire fluency in integration of one variable and apply them to find surface area and volumes.	K5
CO4	Apply the techniques of partial derivatives in functions of several variables.	K5
CO5	Use multiple integration for finding area, surface and volume of different geometry.	K5

COURSE ARTICULATION MATRIX

	a) CO and PO Mapping														
COs/POs	**PO1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	1	1	--	--	--	--	--	--	--	1	--	1	--
CO2	3	3	1	1	--	--	--	--	--	--	--	1	--	1	--
CO3	3	3	1	1	--	--	--	--	--	--	--	1	--	1	--
CO4	3	3	1	1	--	--	--	--	--	--	--	1	--	1	--
CO5	3	3	1	1	--	--	--	--	--	--	--	1	--	1	--
22CBS1Z1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	--	1	--

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO2	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO3	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO4	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1
CO5	1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	30	10	--	--	100
CAT2	20	40	30	10	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	30	10	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	30	10	--	--	100
ESE	20	40	30	10	--	--	100

22CBS1Z2	**ENGINEERING PHYSICS** *(Common to all Branches)*	**SEMESTER I**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**3**	**0**	**0**	**3**

Course Objectives	1.To understand the basics about crystal systems and defects 2.To understand the principle, characteristics, working and applications of laser and optical fiber 3.To solve problems in bending of beams 4.To solve quantum mechanical problems with the understanding of Quantum Principles 5. To understand the properties, production and applications of ultrasonic waves.	
UNIT – I	**CRYSTAL PHYSICS**	**9 Periods**
Introduction – Crystalline and amorphous materials – Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – Reciprocal lattice - d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal defects – Point, line and surface defects.		
UNIT – II	**LASER PHYSICS AND FIBER OPTICS**	**9 Periods**
Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein‘s coefficients - population inversion – methods of achieving population inversion – Optical Resonator -Types of Lasers – Principle, construction and working of CO_2 Laser - applications of laser. Introduction – Basic Principles involved in fiber optics- Total internal reflection–Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change.		
UNIT – III	**PROPERTIES OF MATTER**	**9 Periods**
Elasticity- Hooke’s law- stress-strain diagram - Factors affecting elasticity – Moment (Q) - Couple (Q) – Torque (Q) – Beam - Bending moment - Depression of a cantilever –Twisting Couple- Young’s modulus by uniform bending - I shaped girders.		
UNIT – IV	**QUANTUM PHYSICS AND APPLICATIONS**	**9 Periods**
Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy, and temperature –Heisenberg’s Uncertainty principle – verification – physical significance of a wave function- Schrödinger’s Time independent and Time dependent wave equations –- Particle in a one-dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM).		
UNIT – V	**ULTRASONICS**	**9 Periods**
Introduction - properties of ultrasonic waves - production of ultrasonic waves - Magnetostriction effect-Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonic waves-cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*K. Rajagopal, **“Engineering Physics”**, PHI Learning Private Limited, 2015.*
2	*P. K. Palanisamy, **“Engineering Physics-I”**, Scitech publications Private Limited, 2015.*
3	*M. Arumugam, **“Engineering Physics”**, Anuradha Publishers, 2010.*

REFERENCES:

1	*Arthur Beiser,* ***"Concepts of Modern Physics",*** *Tata McGraw-Hill, 2010.*
2	*D. Halliday, R. Resnick and J. Walker,* ***"Fundamentals of Physics",*** *6th Edition, John Wiley and Sons, 2001.*
3	*William T. Silfvast,* ***"Laser Fundamentals"****, 2nd Edition, Cambridge University Press, New York 2004.*
4	*M. N. Avadhanulu and P.G. Kshirsagar,* ***"A Textbook of Engineering Physics"****, S. Chand and Company Ltd, 2010.*
5	*R. K. Gaur and S. L. Gupta,* ***"Engineering Physics",*** *Dhanpat Rai Publishers, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the crystal structure and analyse the type of defect	K4
CO2	Explain the principle, characteristics, working and applications of laser and optical fiber Analyse and solve problems in laser and optical fiber	K4
CO3	Solve problems in bending of beams Apply the knowledge in construction of buildings	K3
CO4	Explain the importance of quantum mechanics Solve problems in basic quantum physics Apply the wave equations in real time problems	K3
CO5	Explain the properties and production of ultrasonic waves. Apply ultrasonic waves for industrial problems	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	--	--	--	--	--	--	--	--	--	--	1	--	--
CO2	3	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO3	3	2	--	--	--	--	--	--	--	--	--	--	1	2	--
CO4	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	--	--	--	--	--	--	--	--	--	--	1	2	3
22CBS1Z2	**3**	**2**	--	--	--	--	--	--	--	--	--	--	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.3.1, 2.4.1
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	15	15	10	--	100
CAT2	30	30	15	15	10	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	--	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	--	--	--	100
ESE	30	30	15	15	10	--	100

22CBS103	**ENGINEERING CHEMISTRY** *(Common to CIVIL, MECH , PRODN Branches)*	**SEMESTER I**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**3**	**0**	**0**	**3**

Course Objectives	1. To understand the hardness of water, boilers troubles and its treatments. 2. To know about the nomenclature, preparations, properties and industrial applications of various polymers. 3. To acquire basic knowledge about the nanoparticles, its preparations, properties, types and applications in various fields. 4. To understand the basic principles of corrosion, mechanism and its protection methods. 5. To impart the knowledge of preparations, properties of various engineering materials like cements, lubricants and super capacitors.	
UNIT – I	**WATER TECHNOLOGY**	**9 Periods**
Water- sources - types of impurities, Hardness - temporary and permanent – units - ppm and mg/L. 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 process. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis.		
UNIT – II	**POLYMERIC MATERIALS**	**9 Periods**
Definitions and nomenclatures. Preparation, properties and uses of industrially important polymers such as polyethylene, polypropylene, polystyrene and poly (vinyl chloride). Engineering polymers: Preparation, properties and uses of Nylon and Polycarbonates. Organic polymers - Poly acetylene and Poly lactide.		
UNIT – III	**NANO MATERIALS**	**9 Periods**
Nanomaterials and bulk materials; Size-dependent properties (optical, electrical and mechanical) types of nanomaterials: Definition, properties and uses of – nanoparticle, nanorod and nanotube. Preparation of nanomaterials: chemical vapour deposition, electrochemical deposition. Applications of nanomaterials in medicine, agriculture and electronics.		
UNIT – IV	**CORROSION**	**9 Periods**
Corrosion- Definition -Classifications: Chemical Corrosion and Electro chemical corrosion mechanism-Pilling Bedworth rule– Galvanic series and its importance- Preventing Methods-Cathodic protection (sacrificial anode and impressed current conversion method). Protective Coatings-Inorganic coating-surface preparation-Electro plating method applied to Cr and Ni, Organic coating- paints - constituents and functions.		
UNIT – V	**ENGINEERING MATERIALS**	**9 Periods**
Cement – manufacture - setting and hardening of cement. Lubricants: Solid lubricants (Graphite & Molybdenum sulphide) hydrodynamic mechanism of lubrication. Bio fuels: Biogas and biodiesel. Supercapacitors:Storage principle, types and examples.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Jain P. C. & Monica Jain., **"Engineering Chemistry",** 16th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.*
2	*S.S.Dara, **"A text book of Engineering Chemistry"**, Chand Publications, 2014.*

REFERENCES:

1	*Joel R. Fried, **“Polymer Science and Technology”,** Prentice Hall of India Pvt. Ltd., 3rd Edition 2019.*
2	*Friedrich Emich, **“Engineering Chemistry”,** Scientific International Ltd, 2017.*
3	G.B.Sergeev, ***“Nanochemistry”***, Elsevier, 2013.
4	*Baboian, Robert, **“NACE Corrosion Engineer's Reference Book”** ,4th Edition,2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Interpret the different types of hardness related problems.	K3
CO2	Recognize the different types of polymeric materials, properties and its specific applications.	K2
CO3	Implement the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technological applications.	K3
CO4	Describe about the corrosion of the machinery they use in their fields and understand the mechanisms to adopt the preventive measures by various techniques.	K2
CO5	Discuss about the various engineering materials such as cement, lubricants, green fuels and super capacitors which are used in engineering applications.	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	1	2	--	2	1	2	1	--	--	--	--	--	--
CO2	2	2	1	1	--	--	--	--	--	--	--	--	1	--	--
CO3	2	2	1	1	--	--	--	--	1	--	--	--	1	--	--
CO4	2	2	1	1	--	--	1	1	--	--	--	--	1	--	--
CO5	2	2	1	1	1	2	2	--	--	--	--	--	1	--	--
22CBS103	2	2	1	2	1	1	1	1	1	--	--	--	1	--	--

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,2.3.1,3.1.5,4.1.1,4.2.1,4.3.1,4.3.4,6.2.1,7.1.1,8.2.1,8.2.2,9.3.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,2.3.1,3.1.5,4.1.1,4.2.1
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,2.3.1,3.1.5,4.1.1,4.2.1,4.3.1,9.3.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,3.1.5,4.1.1,4.2.1,7.2.2,8.2.2
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,2.3.1,3.1.5,4.1.1,4.2.1,4.3.1,5.1.1,6.1.1,7.1.1,7.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	--	--	100
CAT2	20	40	20	20	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	--	--	100
ESE	20	40	20	20	--	--	100

22CES101	**BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING** *(Common to CIVIL, MECH, PRODN, CSE, IT & IBT Branches)*	**SEMESTER I**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**ES**	**3**	**0**	**0**	**3**

Course Objectives	1.To study the basic concepts of electric circuits, electronic devices and communication engineering. 2. To know the fundamentals of DC and AC machines. 3. To familiar with the basics of Analog and digital electronics. 4. To understand the basics of House wiring. 5. To introduce the components of Electrical installations and energy conservation.	
UNIT – I	**ELECTRICAL CIRCUITS**	**9 Periods**
Electrical circuit elements (R, L and C) - Voltage and Current sources – Ohm's Law – Kirchoff laws – Time domain analysis of First order RL and RC circuits – Representation of sinusoidal waveforms – Average, RMS and Peak values – Phasor representation – Real, Reactive, Apparent power and power factor.		
UNIT – II	**ELECTRICAL MACHINES AND MEASUREMENTS**	**9 Periods**
Construction, Principle of Operation, basic equations and Types, Characteristics and Applications of DC generators, DC motors, Single phase Transformer, Single phase and Three phase Induction motor. Operating principles of Moving coil, Moving iron Instruments (Ammeter and Voltmeters).		
UNIT– III	**ANALOG AND DIGITAL ELECTRONICS**	**9 Periods**
Analog Electronics: Semiconductor devices – P-N junction diode, Zener diode, BJT, Operational amplifier– principle of operation, Characteristics and applications. Digital Electronics: Introduction to numbers systems, basic Boolean laws, reduction of Boolean expressions and implementation with logic gates.		
UNIT – IV	**FUNDAMENTAL OF COMMUNICATION AND TRANSDUCERS**	**9 Periods**
Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations – Resistive, Inductive, capacitive Transducers- Introduction.		
UNIT – V	**ELECTRICAL INSTALLATIONS AND ENERGY CONSERVATION**	**9 Periods**
Single phase and three phase system – phase, neutral and earth, basic house wiring -tools and components, different types of wiring - basic safety measures at home and industry – Energy efficient lamps - Energy billing. Introduction to UPS and SMPS.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*R.Muthusubramaniam, R.Salivaganan, Muralidharan K.A.,* ***"Basic Electrical and Electronics Engineering"*** *Tata McGraw Hill , Second Edition 2010*
2	*Mittle V.N and Aravind Mittal,* ***"Basic Electrical Engineering",*** *Tata McGraw Hill, Second Edition, New Delhi, 2005.*

REFERENCES:

1	*D.P.Kothari, I.J. Nagrath,* ***"Basic Electrical Engineering"****, Tata McGraw Hill, 2010.*
2	*Nagsarkar T.K and Sukhija M.S,* ***"Basic Electrical Engineering"****, Oxford Press, 2005.*
3	*E.Hughes,****"Electrical and Elecronics Technology"****, Pearson, 2010.*
4	*Mohmood Nahvi and Joseph A.Edminister,* ***"Electric Circuits"****, Shaum Outline series, McGraw Hill, Sixth edition, 2014.*
5	*Premkumar N and Gnanavadivel J,* ***"Basic Electrical and Electronics Engineering"****, Anuradha Publishers, 4th Edition, 2008.*
6	*Allan S Morris,* ***"Measurement and Instrumentation Principles"*** *Elsevier, First Indian Edition, 2008.*
7	*S.L. Uppal,* ***'Electrical Wiring Estimating and Costing'****, Khanna publishers, New Delhi, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyze the DC and AC circuits	K4
CO2	Describe the operation and characteristics of Electrical Machines	K4
CO3	Classify and compare various semiconductor devices and Digital electronics.	K3
CO4	Infer the concept of Communication engineering and Transducers.	K2
CO5	Assemble and implement electrical wiring and electrical installations	K6

COURSE ARTICLATION MATRIX

	a) CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	3	3	2	1	--	--	--	--	--	--	--	--	--	1
CO2	2	2	3	2	1	--	2	1	--	--	--	--	--	--	--
CO3	3	2	3	2	1	--	--	--	--	1	--	--	--	--	1
CO4	2	3	3	2	--	--	3	--	--	--	--	1	--	--	--
CO5	2	2	3	2	--	--	--	--	--	--	--	--	--	--	--
22CES101	3	3	3	2	1	--	1	1	--	1	--	1	--	--	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3, 5.2.1, 5.2.2.
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.1, 5.2.1, 5.2.2, 7.2.1, 7.2.2, 8.1.1.
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.2.1, 5.2.2, 10.3.1.
CO4	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 7.1.1, 7.1.2, 7.2.1, 12.3.1, 12.3.2.
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3,2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40		--	--	100
CAT2	35	35	20	10	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	25	25	50		--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	25	25	40	10	--	--	100
ESE	35	35	20	10	--	--	100

22CBS1Z4	**CHEMISTRY LABORATORY** *(Common to all Branches)*		**SEMESTER I**			
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**BS**	**0**	**0**	**3**	**1.5**

Course Objectives	To inculcate the practical applications of Chemistry to students and make them apply in the fields of engineering and technology.

LIST OF EXPERIMENTS	
1.	Estimation of hardness by EDTA method.
2	Conductometric titration of mixture of strong acid and weak acid using strong base.
3.	Estimation of chloride by Argentometric method.
4.	Potentiometric titration of ferrous iron by dichromate.
5.	Determination of Saponification value of an oil.
6.	Estimation of Iron by Spectrophotometry.
7.	Estimation of Dissolved Oxygen.
8.	Estimation of HCl by pH titration.
9.	Estimation of Copper in brass sample.
10.	Estimation of Manganese in Pyrolusite ore.
11.	Anodiziation of aluminium.
12.	Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

REFERENCE BOOKS:

1	*A.O. Thomas, "**Practical Chemistry**", Scientific Book Centre, Cannanore, 2006.*
2	*Vogel's "**Text book of Quantitative Analysis**", Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.*

COURSE OUTCOMES: Upon completion of the course, the student will be able to		**Bloom's Taxonomy Mapped**
CO1	Analyze the quality of water samples with respect to their hardness and DO.	K3
CO2	Determine the amount of metal ions through potentiometric and spectroscopic techniques.	K3
CO3	Infer the strength of an acid, mixtures of acids by pH meter and conductivity cell.	K3
CO4	Estimate the chloride, manganese and copper from various samples.	K3
CO5	Interpret the corrosion rate determination and anodizing method.	K2

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	--	--	--	--	--	--	--	--	--	1	--	--
CO2	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO3	2	1	--	1	--	--	--	--	--	--	--	--	1	--	--
CO4	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--
CO5	2	1	1	1	--	--	1	--	--	--	--	--	1	--	--
22CBS1Z4	2	1	1	1	--	--	1	--	--	--	--	--	1	--	--

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 2.3.1, 3.1.5,
CO2	1.1.1, 1.2.1, 1.3.1, 2.1.2,
CO3	1.1.1, 1.2.1, 2.1.3, 4.1.3,
CO4	1.2.1, 1.3.1, 2.3.1,
CO5	1.1.1, 1.2.1, 1.3.1, 2.3.1, 3.1.5, 4.2.1, 7.1.1,

22CES1Z2	ENGINEERING GRAPHICS *(Common to all branches)*	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	1	0	4	3

Course Objectives	1. To understand the geometrical constructions. 2. To study the various types of projections. 3. To identify different section of solids. 4. To perform the development of surfaces and view of solids. 5. To familiarize with CAD packages.	
UNIT – I	**GEOMETRICAL CONSTRUCTIONS AND PLANE CURVES**	**(3+12 Periods)**
Principles of Engineering Graphics and their significance - Basic geometrical constructions. Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves.		
UNIT – II	**ORTHOGRAPHIC PROJECTIONS**	**(3+12 Periods)**
Introduction to Orthographic Projection - Conversion of pictorial views to orthographic views. Projection of points - Projection of straight lines with traces - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes.		
UNIT – III	**PROJECTION AND SECTION OF SOLIDS**	**(3+12 Periods)**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method. Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.		
UNIT – IV	**DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS**	**(3+12 Periods)**
Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinder and cone. Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids - prisms, pyramids, cylinder, cone- combination of two solid objects in simple vertical positions.		
UNIT – V	**COMPUTER AIDED DRAFTING**	**(3+12 Periods)**
Introduction to computer aided drafting package to make 2D Drawings. Object Construction: Page layout – Layers and line types – Creating, editing and selecting the geometric objects. Mechanics: Viewing, annotating, hatching and dimensioning the drawing – Creating blocks and attributes. Drafting: Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly. (Demonstration purpose only, not to be included in examination).		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods**		

TEXT BOOKS:

1	*K.Venugopal, **"Engineering Graphics"**, New Age International (P) Limited, 2016.*
2	*K.V.Natarajan, **"A text book of Engineering Graphics"**, Dhanalakashmi Publishers, Chennai, 2016.*

REFERENCES:

1	*K.L.Narayana and P.Kannaiah, **"Text book on Engineering Drawing"**, 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*
2	*N.S.Parthasarathy and Vela Murali, **"Engineering Graphics"**, Oxford University Press, New Delhi, 2015.*
3	*K.R.Gopalakrishna, **"Engineering Drawing"** (Vol. I&II combined), Subhas Publications, Bangalore, 2014.*
4	*Basant Agarwal and C.M.Agarwal, **"Engineering Drawing",** Tata McGraw Hill Publishers, New Delhi, 2013.*
5	*Kevin Lang and Alan J.Kalameja, **"AutoCAD 2012 Tutor for Engineering Graphics",** Cengage Learning Publishers, 1st Edition, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Acquire on representing solids as per international standards.	K3
CO2	Impart knowledge on different types of projections.	K3
CO3	Generate and interrupt the true shape of section.	K3
CO4	Develop the various surfaces according to the standards.	K3
CO5	Know the concept of computers in drafting engineering diagrams.	K6

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	1	1	1	2	--	3	1	3	1	3	1	2	2
CO2	3	1	1	1	1	2	--	3	1	3	1	3	1	2	1
CO3	3	1	1	1	1	2	--	3	1	3	1	3	2	2	1
CO4	3	1	1	1	1	2	--	3	1	3	1	3	2	2	2
CO5	3	1	1	1	1	2	--	3	1	3	1	3	2	2	3
22CES1Z2	2	1	1	1	1	2	--	3	1	3	1	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1 ,4.3.3, 5.1.1, 6.2.1, 8.1.1 , 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2

22CHS2Z4	தமிழரும் தொழில் நுட்பமும் TAMILS AND TECHNOLOGY (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

UNIT – I	WEAVING AND CERAMIC TECHNOLOGY	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3 Periods**
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 Periods**
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 Periods**
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 Periods**
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.		
Contact Periods: **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0Periods** **Total: 15 Periods**		

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation ,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

22CHS2Z4	தமிழரும் தொழில் நுட்பமும்TAMILS AND TECHNOLOGY (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	1	0	0	1

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3 Periods
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்– பாண் டங்களில் கீறல் குறியீடுகள்.		
அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3 Periods
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்– சிலப்பதிகாரத்தில் மேடைஅமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும் , கோவில்களும்-சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள்-மாதிரிகட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர்மஹால்– செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.		
அலகு III	உற்பத்தித் தொழில் நுட்பம்	3 Periods
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல் , எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் , கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3 Periods
அணை, ஏரி, குளங்கள் , மதகு – சோழர்காலக் குமுழித்தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு –அறிவுசார் சமூகம்.		
அலகு V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	3 Periods
அறிவியல் தமிழின் வளர்ச்சி கணினித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.		
Contact Periods: **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**		

TEXT BOOK:

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

REFERENCES:

1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies.
3	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)
5	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay Published by: The Author)
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

22CHS2Z5	**PROFESSIONAL ENGLISH** *(Common to all Branches*)	**SEMESTER II**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
	HSMC	**2**	**1**	**0**	**3**

Course Objectives	1. To engage learners in meaningful language activities to improve their LSRW skills 2. To enhance learners' awareness of general rules of writing for specific audiences 3. To help learners understand the purpose, audience, contexts of different types of writing 4. To develop analytical thinking skills for problem solving in communicative contexts 5. To demonstrate an understanding of job applications and interviews for internship and placements	
UNIT – I	**FUNDAMENTALS OF COMMUNICATION**	**9 Periods**
Listening – Listening to Personal Introduction and Filling a form Speaking - Self Introduction; Introducing someone in a formal context Reading -Reading Biographies/ Autobiographies and E-mails relevant to technical contexts. Writing - Writing Biographies/ Autobiographies; Drafting Professional E-mails. Grammar - Present Tense (Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous); Parts of Speech Vocabulary - Word Formation with Prefixes; Antonyms; Portmanteau Words		
UNIT – II	**SUMMATION AND PROBLEM SOLVING**	**9 Periods**
Listening - Listening to Short-Stories / Personal Experiences/Watching Movies. Speaking - Narrating Personal Experiences / Events and Short Stories Reading - Reading Travelogues and Books. Writing - Report on an event (Field Trip, Industrial Visit, Educational Tours etc.), Review on Books and Movies. Grammar –Past Tense (Simple Past, Past Progressive, Past Perfect, Past Perfect Continuous); Impersonal Passive Vocabulary - Word Formation with suffixes; Synonyms; Phrasal Verbs.		
UNIT – III	**DESCRIPTION OF A PROCESS / PRODUCT**	**9 Periods**
Listening - Listening to Digital Marketing Advertisements for Product /Process Descriptions Speaking –Describing/Interpreting a Picture; Giving instructions to use the product. Reading – Reading Advertisements, Gadget Reviews; User Manuals. Writing - Writing Definitions; Product /Process Description; Transcoding; Content Writing Grammar -Future Tense(Simple Future, future continuous, Future Perfect, Future Perfect Continuous); If Clauses Vocabulary - Homonyms; Homophones, One Word Substitutes.		
UNIT – IV	**EXPRESSION**	**9 Periods**
Listening–Listening to/Watching Formal Job interviews or Celebrity Interviews Speaking – Participating in a Face to Face or Virtual Interview (Job/Celebrity Interview), virtual interviews Reading – Company profiles, Statement of Purpose, (SOP), Excerpts of interview with professionals from Newspaper, Magazine and other Resources Writing – Job / Internship Application – Cover letter & Resume Grammar – Question types: 'Wh' / Yes or No/ and Tags; Subject- Verb Agreement. Vocabulary – Idiomatic Expressions		
UNIT – V	**PUBLIC SPEAKING**	**9 Periods**
Listening – Listening to Ceremonious Speeches on You Tube and Jotting down phrases Speaking – Delivering Welcome Address; Introducing the Chief-Guest; Proposing Vote of Thank and Felicitation Reading – Excerpts of Speeches from Newspaper, Magazines and Motivational Books Writing – Drafting a Welcome Address, Introduction to the Chief-Guest, Vote of Thanks and Felicitation Grammar –Common Errors Vocabulary – Commonly Confused Words		
Contact Periods: **Lecture: 30 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	***"English for Science & Technology"*** *Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.*
2	***Communicative English,*** *Global Publishers, Chennai 2017 by Dr.J.Anbazhagan Vijay*

REFERENCES

1	*Raman.Meenakshi ,Sharma.Sangeeta(2019).* ***Professional English.*** *Oxford University Press. New Delhi.*
2	***Learning to Communicate*** *– Dr. V. Chellammal, Allied Publishing House, New Delhi,2003*
3	***Using English****, Orient Blackswan, Chennai, 2017 by Board of Editors*
4	***OER****(Authentic Open Educational Resources)*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Participate in a basic communicative task.	K3
CO2	Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.	K3
CO3	Describe a product or process or mechanism.	K2
CO4	Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.	K3
CO5	Deliver speeches at formal functions.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	--	--	1	--	--	2	--	--	3	3	--	--	-	1	-
CO2	--	1	1	--	--	2	--	--	1	3	--	1	-	1	-
CO3	--	--	--	1	--	--	--	--	--	3	--	--	-	1	-
CO4	--	--	1	--	--	--	--	--	2	3	--	--	-	1	-
CO5	--	--	--	--	--	--	--	--	2	2	--	--	-	1	-
22CH2Z5	--	1	1	1	--	1	--	--	2	3	--	1	-	**1**	-

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	3.3.2, 6.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO2	2.1.1, 2.2.3, 2.2.4, 3.1.2, 6.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 12.3.1, 12.3.2
CO3	4.1.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO4	3.3.2, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2
CO5	9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	--	12	88	--	--	--	100
CAT2	--	18	82	--	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	--	--	100	--	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	--	--	100	--	--	--	100
ESE	--	20	80	--	--	--	100

22CBS205	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS *(Common to all Branches except CSE & IT)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To gain knowledge of methods to solve higher order differential equations with constant and variable coefficients. 2. To be familiar with forming partial differential equations and solving partial differential equations of standard types of first order and homogeneous linear differential equations. 3. To be familiar with numerical interpolation, numerical differentiation and numerical integration. 4. To acquire the knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques. 5. To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.	
UNIT – I	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Higher order linear differential equations with constant coefficients -variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation-Method of variation of parameters-Simultaneous first order linear equations with constant coefficients.		
UNIT – II	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Formation of partial differential equations – First order partial differential equations – Standard types and Lagrange’s type – Homogeneous linear partial differential equation of second and higher order with constant coefficients.		
UNIT – III	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9+3 Periods**
Solution of polynomial and transcendental equations: Newton-Raphson method-Interpolation with equal interval: Newton’s forward and backward difference formulae-Interpolation with unequal intervals: Lagrange’s formulae-Numerical Differentiation: Newton’s formulae-Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules.		
UNIT – IV	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
First order ordinary differential equations: Taylor’s series method-Euler and modified Euler’s methods-Runge- Kutta method of fourth order -Milne’s and Adam’s predicator-corrector methods.		
UNIT – V	**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
Partial differential equations: Finite difference method for two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for wave equation.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 15 Periods** **Practical: 0 Periods** **Total: 60 Periods**		

TEXT BOOK

1	*Veerarajan.T, **"Engineering Mathematics"**, Revised Edition 2018, McGraw Hill Education (India) Private Limited*
2	*P. Kandasamy, K. Thilagavathy, K. Gunavathi, **" Numerical Methods"**, S. Chand & Company, 3rd Edition, Reprint 2013.*

REFERENCES

1	*B.S.Grewal, **" Higher Engineering Mathematics"**, Khanna Publishers, New Delhi, 44thEdition, 2018.*
2	*SrimantaPal, **"Numerical Methods Principles, Analyses and Algorithms"**, Oxford University Press, New Delhi, IstEdition 2009.*
3	*Raisinghania.M..D, **"Ordinary And Partial Differential Equations"**, 20th Edition, S. Chand Publishing,2020*
4	*S.S. Sastry, **"Introductory methods of numerical analysis"**, PHI, New Delhi, 5th Edition, 2015.*
5	*Ward Cheney, David Kincaid, **"Numerical Methods and Computing,** Cengage Learning**,** Delhi, 7th Edition 2013.*
6	*S. Larsson, V. Thomee, **"Partial Differential Equations with Numerical Methods"**, Springer, 2003.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Solve higher order linear differential equation with constant and variable coefficients and simultaneous differential equation.	K5
CO2	Form partial differential equations and find solutions of first and higher order partial differential equations.	K5
CO3	Obtain approximate solutions for transcendental equations and problems on interpolation, differentiation, integration.	K5
CO4	Find the numerical solutions of first order ordinary differential equations using single and multi step techniques.	K5
CO5	Solve second order partial differential equations using explicit and implicit methods.	K5

COURSE ARTICULATION MATRIX

COs/POs	a) CO and PO Mapping														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	--	1	--	--	--	--	--	--	--	1	2	2	1
CO2	3	3	--	1	--	--	--	--	--	--	--	1	2	2	1
CO3	3	3	--	1	--	--	--	--	--	--	--	1	2	2	1
CO4	3	3	--	1	--	--	--	--	--	--	--	1	2	2	1
CO5	3	3	--	1	--	--	--	--	--	--	--	1	2	2	1
22CBS205	3	3	--	1	--	--	--	--	--	--	--	1	**2**	**2**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1,12.2.1
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1,12.2.1
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1,12.2.1
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1,12.2.1
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1,12.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	20	20	--	--	100
CAT2	20	40	20	20	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	--	--	100
ESE	20	40	20	20	--	--	100

22CES203	**ENGINEERING MECHANICS** *(Common to Civil ,EEE & PRODN Branches)*	**SEMESTER II**

PREREQUISITES:	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**ES**	**3**	**0**	**0**	**3**

Course Objectives	1. To learn the basic principles and concepts of force system. 2. To gain knowledge on different kinds of friction. 3. To understand the concepts of centre of gravity and moment of inertia. 4. To understand the Kinematics and kinetics of rigid body motion. 5. To study the dynamics of particles, impulse and momentum Principles.

UNIT – I	**BASIC CONCEPTS OF FORCES**	**9 Periods**
Basic Concepts and Principles of Forces– Laws of Mechanics – System of forces in Plane – Free body Diagrams- resultant of a force system – resolution and composition of forces – Lami’s theorem –moment of a force – physical significance of moment-Varignon’s theorem – resolution of a force and couple system– forces in space – addition of concurrent forces in space – equilibrium of a particle in space.		
UNIT – II	**STATIC AND DYNAMIC FRICTION**	**9 Periods**
Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle offriction – angle of repose — cone of friction – advantages - equilibrium of a body on a rough inclinedplane –ladder friction – rope friction – wedge friction.		
UNIT – III	**PROPERTIES OF SECTION**	**9 Periods**
Centroid and Centre of Gravity for simple & Composite sections– theorems of moment of inertia Determination of moment of inertia of various sections –Product of Inertia – Principal moment of inertia of plane areas - Mass moment inertia of circular plate, Cylinder, Cone, Sphere.		
UNIT – IV	**BASICS OF DYNAMICS - KINEMATICS**	**9 Periods**
Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion –Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration– motion under gravity – relative motion – curvilinear motion of particles – projectiles– angle of projection – range – time of flight and maximum height.		
UNIT – V	**BASICS OF DYNAMICS - KINETICS**	**9 Periods**
Newton’s second law of motion – linear momentum – D’Alembert’s principle, Dynamic equilibrium–equation of particles-principle of work and energy –law of conservation of energy –Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*F.B. Beer and E.R. Johnson, **“Vector Mechanics for Engineers”**, Tata Mc.Graw Hill Pvt Ltd,11th Edition, 2013.*
2	*Rajasekaran S & Sankara Subramanian, **“Fundamentals of Engineering Mechanics”**, Vikas Publishing House Pvt Ltd. 3rdEdition, 2017.*

REFERENCES:

1	*S. Timoshenko and Young,* ***"Engineering Mechanics"****, McGraw Hill, 4th Edition, 2017.*
2	*Bansal R.K,* ***"A Text Book of Engineering Mechanics"****, Laxmi Publications, 2015.*
3	*R.C. Hibbeller,* ***"Engineering Mechanics"****, Prentice Hall of India Ltd, 14th Edition, 2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize the principles and Concepts of Mechanics	K2
CO2	Calculate the friction force acting on a plane under various conditions.	K3
CO3	Determine the centre of gravity and moment of inertia for different sections.	K3
CO4	Predict the Rectilinear and curvilinear motion of particles.	K3
CO5	Evaluate the dynamics of particles using kinetic principles.	K4

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	--	--	2	--	--	--	--	--	--	1	2	2
CO2	3	2	1	--	--	2	--	--	--	--	--	1	--	2	3
CO3	3	3	1	--	--	2	--	--	--	--	--	--	--	2	3
CO4	3	3	1	--	--	2	--	--	--	--	--	1	1	2	3
CO5	3	3	1	--	--	2	--	--	--	--	--	1	1	2	3
22CES203	3	3	1	--	--	2	--	--	--	--	--	1	1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1
CO2	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2
CO5	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 6.1.1, 12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	30	10	--	--	100
CAT2	30	30	30	10	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	30	10	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	30	10	--	--	100
ESE	30	30	30	10	--	--	100

22CES204	**PROGRAMMING IN C** *(Common to all branches except MECH & PRODN)*	**SEMESTER II**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**ES**	**3**	**0**	**0**	**3**

Course Objectives	1. To study the basic concepts of computer and programming fundamentals. 2. To understand the data types in C, flow control statements, Arrays, Functions Pointers, Structures, Unions and File concepts in C.	
UNIT – I	**COMPUTER AND PROGRAMMING FUNDAMENTALS**	**9 Periods**
Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O –Introduction to software –Classification of programming languages – Compiling –Linking and loading a program – Introduction to OS – Types of OS.		
UNIT – II	**DATA TYPES AND FLOW OF CONTROL**	**9 Periods**
Structured programming – Algorithms – Structure of a C program – Variables – Data types – Operators and expressions – Input and Output statements – Tokens –Type Conversion – Control statements.		
UNIT – III	**ARRAYS AND FUNCTIONS**	**9 Periods**
1D Arrays– 2D Arrays – Multidimensional Arrays – Strings – String handling functions – Functions – Recursion – Array as function arguments – Storage Classes – Enumerations.		
UNIT – IV	**POINTERS**	**9 Periods**
Introduction to pointers – Pointer's arithmetic – call by reference – Relationship between Array and Pointers – Relationship between String and pointers – pointers to pointers – array of pointers – pointers to an array – Dynamic memory allocation – Arguments to main ().		
UNIT – V	**STRUCTURES AND UNIONS, FILE OPERATIONS**	**9 Periods**
Preprocessor directives – Structures – Unions – Bit fields – Opening and closing a file – Working with file of records – Random access to file of records.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Pradip Dey, Manas Ghosh, **"Computer Fundamentals and Programming in C",** Second Edition, Oxford University Press, 2018*

.

REFERENCES

1	*Al Kelley, Ira Pohl, **"A Book on C- Programming in C", Fourth** Edition, Addison Wesley,2001.*
2	*Herbert Schildt , **"C: The Complete Reference",** Fourth Edition, McGraw Hill Education, 2017.*
3	*Yashavant P. Kanetkar, **"Let Us C",**15th edition, BPB Publications,2016.*
4	*Brian W. Kernighan and Dennis Ritchie, **"The C Programming Language",** Second Edition, Prentice Hall Software Series, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Articulate the basics of computer and evolution of programming languages.	K1
CO2	Write simple C programs using appropriate data types and control statements	K3
CO3	Write C programs using arrays, functions and enumerations	K3
CO4	Use pointers effectively to develop programs	K3
CO5	Create user defined data types using structures & union and effectively manipulate them in file operations.	K6

COURSE ARTICULATION MATRIX :															
	a)CO and PO Mapping														
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	1	3	1	--	--	--	--	--	--	--	--	1	3	--	--
CO2	1	3	1	--	--	--	--	--	--	--	--	1	3	--	--
CO3	1	3	1	--	--	--	--	--	--	--	--	1	3	--	--
CO4	1	3	1	--	--	--	--	--	--	--	--	1	3	--	--
CO5	1	3	1	--	--	--	--	--	--	--	--	1	3	--	--
22CES204	1	3	1	--	--	--	--	--	--	--	--	1	**3**	--	--
1 – Slight, 2 – Moderate, 3 – Substantial															

a) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 12.2.1
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2
CO3	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1,12.1.2
CO4	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2,
CO5	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2

ASSESSMENT PATTERN - THEORY							
Test / Bloom's Category*	**Remembering (K1)%**	**Understanding (K2)%**	**Applying (K3)%**	**Analyzing (K4)**	**Evaluating (K5)%**	**Creating (K6)%**	**Total %**
CAT1	50	20	30	--	--	--	100
CAT2	20	30	50	--	--	--	100
Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1	50		50	--	--	--	100
Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2			100	--	--	--	100
ESE	20	30	50	--	--	--	100

22CMC2Z1	**ENVIRONMENTAL SCIENCE AND ENGINEERING** *(Common to all Branches)*	**SEMESTER II**

PREREQUISITES	CATEGORY	L	T	P	C
NIL	**MC**	**3**	**0**	**0**	**0**

Course Objectives	1. To study the modern agriculture related problems, natural resources and its harnessing methods. 2. To study the interrelationship between living organism and environment. 3. To educate the people about causes of pollutions and its controlling methods. 4. To impart the knowledge of various environmental threats and its consequences. 5. To study the various water conservation methods, Act, Population policy, Welfare programs.	
UNIT – I	**ENVIRONMENTAL ENERGY RESOURCES**	**9 Periods**
Food-effects of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications-Energy resources: renewable resources - Hydro Energy, Solar & Wind. Non-renewable resources – Coal and Petroleum - harnessing methods.		
UNIT – II	**ECO SYSTEM AND BIODIVERSITY**	**9 Periods**
Eco system and its components - biotic and abiotic components. Biodiversity: types and values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity: In situ and ex situ conservation. Threats to biodiversity-destruction of habitat, habit fragmentation, hunting, over exploitation and man-wildlife conflicts. The IUCN red list categories.		
UNIT – III	**ENVIRONMENTAL POLLUTION**	**9 Periods**
Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 and particulates. Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollution. Noise pollution - decibel scale, sources, effects and control.		
UNIT – IV	**ENVIRONMENTAL THREATS**	**9 Periods**
Global warming-measure to check global warming - impacts of enhanced Greenhouse effect, Acid rain-effects and control of acid rain, ozone layer depletion- effects of ozone depletion, disaster management - flood, drought, earthquake and tsunami.		
UNIT – V	**SOCIAL ISSUES AND ENVIRONMENT**	**9 Periods**
Water conservation, rain water harvesting, e-waste management, Pollution Control Act, Wild life Protection Act. Population growth- exponential and logistic growth, variation in population among nations, population policy. Women and Child welfare programs. Role of information technology in human and health, COVID-19 - effects and preventive measures.		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods**		

TEXT BOOK:

1	*Sharma J.P.,* ***"Environmental Studies"****, 4th Edition, University Science Press, New Delhi 2016.*
2	*Anubha Kaushik and C.P.Kaushik,* ***"Environmental Science and Engineering"****, 7th Edition, New Age International Publishers, New Delhi, 2021.*

REFERENCES:

1	*A K De, **"Environmental Chemistry"**, 8th Edition, New Age International Publishers, 2017.*
2	*G. Tyler Miller and Scott E. Spoolman, **"Environmental Science"**, Cengage Learning India Pvt, Ltd, Delhi, 2014.*
3	*Erach Bharucha, **"Textbook of Environmental Studies"**, Universities Press(I) Pvt, Ltd, Hyderabad, 2015.*
4	*Gilbert M.Masters, **"Introduction to Environmental Engineering and Science"**, 3rd Edition, Pearson Education, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Recognize and understand about the various environmental energy resources and the effective utility of modern agriculture.	K2
CO2	Acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.	K2
CO3	Be aware of the sources of various types of pollution, their ill effects and preventive methods.	K2
CO4	Identify and take the preventive measures to control the environmental threats and effects of Global warming, Ozone depletion, Acid rain, and natural disasters.	K2
CO5	Demonstrate an idea to save water and other issues like COVID -19.	K2

COURSE ARTICULATION MATRIX

a)CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	--	--	3	--	--	--	--	--	1	--	--
CO2	--	--	1	--	--	--	3	--	--	--	--	--	--	--	--
CO3	2	1	1	1	--	--	3	--	--	--	--	--	1	--	--
CO4	2	1	1	1	--	--	3	--	--	--	--	--	--	--	--
CO5	--	1	1	1	--	2	3	--	--	--	--	--	--	--	--
22CMC2Z1	2	1	1	1	--	1	3	--	--	--	--	--	**1**	--	--

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.4.1,2.1.2,2.3.1,3.1.5,3.2.1,4.3.1,7.1.1,7.1.2,7.2.1
CO2	3.1.5,7.1.1,7.1.2,7.2.1
CO3	1.2.1,1.3.1,1.4.1,2.1.2,2.3.1,3.1.5,3.2.1,4.1.3,4.3.1,7.1.1,7.1.2,7.2.1
CO4	1.2.1,1.4.1,2.1.2,2.3.1,3.1.5,4.1.3,4.3.1,7.1.1,7.1.2,7.2.1,7.2.2
CO5	2.1.2,2.2.2,3.1.5,4.1.3,4.3.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	--	--	100
CAT2	20	40	20	20	--	--	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	--	--	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	20	20	--	--	100
ESE	20	40	20	20	--	--	100

22CBS2Z6	**PHYSICS LABORATORY** *(Common to all Branches)*	**SEMESTER II**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**0**	**0**	**3**	**1.5**

Course Objectives	1. To impart practical knowledge on the concept of properties of matter and utilize the experimental techniques to measure the properties 2. To impart practical knowledge on the modulii of elasticity 3. To analyze the properties of semiconductors 4. To learn practically the basic electronic concepts of transistor and logic gates 5. To realize the principle, concepts and working of a solar cell and study the properties of ferromagnetic material. 6. To understand the concept of quantum physics
S. No.	**LABORATORY EXPERIMENTS**
1.	Determination of refractive index of the glass and given liquid – Spectrometer diffraction method
2.	Determination of Planck's constant
3.	Determination of Young's Modulus of the material in the form of bar – Cantilever Bending -Koenig's Method
4.	a) Particle size determination using diode laser b) Determination of numerical aperture and acceptance angle in an optical fiber
5.	Hall effect - Determination of semiconductor parameters
6.	Determination of band gap of semiconductor material
7.	Determination of velocity of sound and compressibility of the given liquid-Ultrasonic Interferometer
8.	Determination of moment of inertia of disc and rigidity modulus of a wire-Torsional pendulum
9.	Transistor characteristics
10.	Solar cell characteristics
11.	Determination of Hysteresis losses in a Ferromagnetic material-B-H curve unit
12.	Logic Gates – Verification and Construction
Contact Periods: **Lecture: 0 Periods** **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**	

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determine refractive index and compressibility of liquids, micro size of particles and numerical aperture of an optical fibre	K5
CO2	Measure the Young's and rigidity modulii of the given material	K5
CO3	Determine the bandgap of a given semiconductor material and identify the type of semiconductor and its carrier concentration through Hall measurement	K5
CO4	Analyze the characteristics of transistor and verify the truth table of logic gates	K4
CO5	Measure the efficiency of a solar cell and energy loss associated with the ferromagnetic material by plotting B-H curve	K5
CO6	Determine the Planck's constant and work function.	K5

COURSE ARTICULATION MATRIX
a)CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
22CBS2Z6	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**1**	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b)CO AND KEY PERFORMANCE INDICATORS MAPPING	
CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO2	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO3	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO4	1.1.1,1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4
CO6	1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4

22CES2Z5	**WORKSHOP PRACTICE** *(Common to all Branches)*	**SEMESTER II**

PREREQUISTES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	1. To make various basic prototypes in the carpentry trade such as Half Lap joint, Lap Tee joint, Dovetail joint, Mortise & Tenon joint. 2. To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. 3. To make various moulds in foundry such as Cube, Straight pipe, Vpulley, and Conical bush. 4. To make various components using sheet metal such as Tray, Frustum of cone and square box. 5. To understand the working and identify the various components of CNC Machines

LIST OF EXPERIMENTS

1. Introduction to use of tools and equipment's in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry, Foundry and sheet metal.
3. Half Lap joint and Dovetail joint in Carpentry.
4. Welding of Lap joint and Butt joint and T-joint.
5. Preparation of Sand mould for Cube, Conical bush, Pipes and V pulley
6. Fabrication of parts like Tray, Frustum of cone and square box in sheet metal
7.CNC Machines demonstration and lecture on working principle.
8.Electrical wiring and simple house wiring.

Contact periods:

Lecture: 0 Periods	Tutorial: 0 Periods	Practical: 45 Periods	Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Safely use the tools and equipment's in Carpentry, Welding, Foundry and Sheet metal to create basic joints.	K2
CO2	Prepare sand mould for various basic pattern shapes.	K3
CO3	Fabricate parts like Tray, Frustum of cone and square box in sheet metal.	K3
CO4	Practice on the Welding and Carpentry	K3
CO5	Demonstrate the working of CNC Machines.	K2

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	2	2	3	2	1	3	1	2	3	3	2	3	3	1	--
CO2	2	2	3	2	1	3	3	2	3	3	2	3	2	1	1
CO3	2	2	3	2	1	3	3	2	3	3	2	3	2	1	1
CO4	2	2	3	2	1	3	3	2	3	3	2	3	2	2	3
CO5	2	2	3	2	3	--	--	2	3	3	2	2	--	1	--
22CES2Z5	2	2	3	2	2	3	2	2	3	3	2	3	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

	b) CO and Key Performance Indicators Mapping
CO1	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1,6.2.1,7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4,9.3.1,10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1,6.2.1,7.1.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1,6.2.1,7.1.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1,6.2.1,7.1.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1,3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1,5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1, 12.3.2

22CES206	PROGRAMMING IN C LABORATORY *(Common to all branches except Mechanical & Production)*	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	To understand the concepts like Data types, Flow control statements, Functions, Arrays, command line arguments, Pointer, Dynamic memory allocation, Preprocessor Directives, Structures, Unions and Files in C

EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:

1	Operators, Expressions and IO formatting
2	Decision Making and Looping
3	Arrays and Strings
4	Functions and Recursion
5	Pointers
6	Dynamic Memory Allocation
7	Command line arguments
8	Preprocessor Directives
9	Structures
10	Unions
11	Files
12	Mini Project

Contact periods:

Lecture: 0 Periods	**Tutorial: 0 Periods**	**Practical: 45 Periods**	**Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use appropriate data types and flow control statements to write C programs	K6
CO2	Write C programs using arrays, functions and command line arguments	K6
CO3	Write C programs using pointers, dynamic memory allocation and preprocess or directives	K6
CO4	Implement user defined data types using structures & union and effectively manipulate them in file operations.	K6
CO5	Develop simple applications using C	K6

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	3	1	1	--	--	--	--	--	--	--	--	3	--	--
CO2	2	3	1	1	--	--	--	--	--	--	--	--	3	--	--
CO3	2	3	1	1	--	--	--	--	--	--	--	--	3	--	--
CO4	2	3	1	1	--	--	--	--	--	--	--	--	3	--	--
CO5	2	3	2	1	--	--	--	--	3	3	--	--	3	--	--
22CES206	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	3	--	--

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO2	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO3	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO4	1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1
CO5	1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.3, 3.3.1

22CBS307	**TRANSFORM CALCULUS AND PARTIAL DIFFERENTIAL EQUATIONS** *(Common to Civil and IBT Branches)*	**SEMESTER III**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**3**	**1**	**0**	**4**

Course Objectives	To be familiar with Fourier Series. To gain the knowledge of solving Boundary value problems. To be familiar with Laplace and Inverse Laplace transforms to solve ordinary differential equations.To acquire knowledge on Fourier transforms.To be familiar with Z-transform to solve difference equations.

UNIT – I	**FOURIER SERIES**	**9 Periods**
Dirichlet's Conditions – General Fourier series – Odd and even functions - Half range Sine and Cosine series – Root Mean Square Value- Parseval's Identity on Fourier series–Harmonic Analysis		
UNIT – II	**BOUNDARY VALUE PROBLEMS**	**9 Periods**
Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Infinite Stripes in cartesian coordinates only).		
UNIT – III	**LAPLACE TRANSFORMS**	**9 Periods**
Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties –Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transforms - Statement of Convolution theorem – Initial and final value theorems – Solution of linear ordinary differential equation of second order with constant coefficients using Laplace transformation techniques.		
UNIT – IV	**FOURIER TRANSFORMS**	**9 Periods**
Statement of Fourier integral Theorem – Fourier transform pair–Fourier Sine and Cosine Transforms – Properties – Transforms of Simple functions – Convolution Theorem – Parseval's Identity.		
UNIT – V	**Z TRANSFORMS**	**9 Periods**
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 to difference equations of second order with constant coefficients using Z- transform		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOKS:

1	*Veerarajan. T.,**"Transforms and partial Differential equations"**, Tata McGrawHill Publishing Co., New Delhi. 2015.*
2	*B.S.Grewal.,**"Higher Engineering Mathematics"**, Khanna Publishers, NewDelhi,44th Edition,2018.*

REFERENCES

1	*Kandasamy, Thilagavathy and Gunavathy.,**"Engineering Mathematics"** for III Semester, S. Chand & Co, Ramnagar, New Delhi.*
2	*N.P.Bali and Manish Goyal.,**"Transforms and partial Differential equations"**, University Science Press, New Delhi, 2010.*
3	*Veerarajan T.,**"Engineering Mathematics"** for Semester I&II, Tata McGraw Hill Education (India) Pvt. Ltd., New Delhi, Third Edition 2012.*
4	*Erwinkreyszig,**"Advanced Engineering Mathematics"**,9th Edition, John Wiley & Sons,2006.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Express the periodic functions arising in the study of engineering problems as sine and cosine series.	K3
CO2	Solve the Partial Differential Equations arising in engineering problems like Wave, Heat flow and Laplace equation in steady state (Cartesian coordinates) using Fourier series.	K3
CO3	Apply Laplace transform technique to solve the given integral equations and ordinary differential equations.	K3
CO4	Find Fourier Transforms, infinite Fourier Sine and Cosine transforms.	K3
CO5	Apply Z - transform technique to solve difference equations	K3

COURSE ARTICULATION MATRIX

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	-	-	-	-	1	2	1
22CBS307	3	2	-	-	-	-	-	-	-	-	-	-	-	1	1
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1
CO2	1.1.1, 1.1.2,1.21, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Rememberin g (K1) %	Understanding (K2) %	Applying (K3) %	Analyzin g (K4) %	Evaluatin g (K5) %	Creating (K6) %	Total %
CAT1	20	30	50	-	-	-	100
CAT2	20	30	50	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	20	30	50	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	20	30	50	-	-	-	100
ESE	20	30	50	-	-	-	100

22CES307	MECHANICS OF FLUIDS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	To impart the knowledge on properties and behavior of fluid at static and dynamic conditions to solve various fluid flow problems.	
UNIT – I	**BASICCONCEPTS ANDFLUIDSTATICS**	**9 Periods**
Properties of fluids- Density, specific gravity, viscosity, surface tension, capillarity, compressibility, bulk modulus. Fluid statics – Pascal's Law - Pressure measurement – Manometers. Hydrostatic forces on plane and curved surfaces –Stability of floating bodies – Buoyancy–Metacentre and metacentric height-simple problems.		
UNIT – II	**PRINCIPLES OF MASS**	**9 Periods**
Eulerian Vs.Lagrangian descriptions – Classification of fluid flow – Stream line, path line and streakline – Continuity equation – Velocity – Acceleration of a fluid particle - tangential, normal, local and convective acceleration-Velocity potential and stream functions – Free and Forced vortex flow.		
UNIT – III	**PRINCIPLE OF ENERGY**	**9 Periods**
Energy and its forms, Energy equation – Euler's and Bernoulli's equation – Applications - Venturimeter, Orificemeter and Pitot tube - Flow over Notches and Weirs.		
UNIT – IV	**FLOW THROUGH CONDUITS**	**9 Periods**
Laminar flow in pipes and between parallel plates - Hagen Poiseuille equation for flow through circular pipes - Turbulent flow – Reynolds experiment –Frictional loss in pipe- Darcy – Weisbach equation - Hydro dynamically smooth and rough boundaries, velocity distributions for turbulent flow in smooth and rough pipes.		
UNIT – V	**BOUNDARY LAYER AND FLOW AROUND IMMERSED BODIES**	**9 Periods**
Boundary layer - Definition – Boundary layer thickness - Displacement, energy and momentum thickness - Boundary layer separation - Flow around immersed objects – Drag and lift on immersed bodies – Magnus effect.		
Contact Periods: **Lecture:45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*R.K.Bansal,* ***"Fluid Mechanics and Hydraulic Machines"****,LaxmiPublications(P)Ltd., NewDelhi, 2019.*
2	*P.N.ModiandS.M.Seth,* ***"HydraulicsandFluidMechanics,IncludingHydraulicMachines"****,StandardBookHouse, NewDelhi, 2015.*

REFERENCES:

1	*K.L.Kumar,"* ***EngineeringFluid Mechanics*** *",Eurasia Publishing House(P)Ltd., New Delhi,2020.*
2	*R.K.Rajput,"* ***A Text Book of Fluid Mechanics and Hydraulic Machines*** *", S.Chand and Company, NewDelhi, 2015.*
3	*A.K.Jain,"* ***Fluid Mechanics*** *",Khanna Publishers,New Delhi,2021.*
4	*M.K.Natarajan"* ***Principles of Fluid Mechanics*** *", Anuradha Agencies,Vidayal Karuppur,Kumbakonam, 2008*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the properties of fluids and fluid statics	K2
CO2	Apply the continuity equation for solving fluid flow problems.	K3
CO3	Apply the principles of Euler's equation and Bernoulli's equation in real situation of fluid problems	K3
CO4	Examine the fluid flow behavior for laminar and turbulent flows.	K3
CO5	Analyze the boundary layer separation drag and lift on immersed bodies.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
22CES 307	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20				100
CAT2	40	40	20				100
Individual Assessment 1 / Case Study 1/ Seminar 1/ Project1	40	40	20				100
Individual Assessment 2 / Case Study 2/ Seminar 2/ Project 2	40	40	20				100
ESE	40	40	20				100

<table>
<tr><td>22CES308</td><td colspan="5">ENGINEERING GEOLOGY</td><td colspan="4">SEMESTER III</td></tr>
<tr><td colspan="4">PREREQUISITES</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="4">NIL</td><td>ES</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Objectives</td><td colspan="8">This course will familiarize the students on the role and importance of geology in civil engineering, apart from learning the methods of surface and subsurface investigations using geological, geophysical and remote sensing methods.</td></tr>
<tr><td>UNIT – I</td><td colspan="6">INTRODUCTION AND GEOMORPHOLOGY</td><td colspan="2">9 Periods</td></tr>
<tr><td colspan="9">Interrelationship between Geology and civil engineering – Branches of Geology – Earth Structure and composition –Concept of Plate tectonics, Geological processes, agents and kinds – Weathering, wind, rivers and their Engineering significance - Volcano – Landforms, Materials and Types of Eruptions, Ground water – Properties of rock – Geological work of ground water.</td></tr>
<tr><td>UNIT – II</td><td colspan="6">MINERALOGY</td><td colspan="2">9 Periods</td></tr>
<tr><td colspan="9">Physical and Chemical properties of minerals – Study of the following rock forming minerals – Quartz family, Felspar family, Biotite, Muscovite, Calcite, Magnesite, Ore minerals - Hematite, Magnetite, Bauxite, Graphite, Coal and Oil and natural gas – Clay minerals – Properties and their economic uses.</td></tr>
<tr><td>UNIT – III</td><td colspan="6">PETROLOGY AND GEOTECHNICAL PROPERTIES OF ROCKS</td><td colspan="2">9 Periods</td></tr>
<tr><td colspan="9">Formation of Igneous rocks, Sedimentary rocks and Metamorphic rocks, Texture and Structure, Classification and Engineering properties of Granite, Pegmatite, Dolerite and Basalt., formation and Engineering properties of Sandstone, Limestone and Shale. Agents, kinds and Engineering properties of metamorphic rocks - Quartzite, Marble, Slate, Gneiss and schist. Influence on strength of rocks. Rock Mass Rating (RMR), Rock Quality Designation (RQD), Geological Strength Index (GSI).</td></tr>
<tr><td>UNIT – IV</td><td colspan="6">STRUCTURAL GEOLOGY & ELEMENTS OF SEISMOLOGY</td><td colspan="2">9 Periods</td></tr>
<tr><td colspan="9">Attitude of beds Dip and Strike - Uses of Clinometer compass – Outcrops – Geological maps – their uses – Structural features – Folds, Faults and Joints – their engineering significance. - Earthquakes – Causes and effects, Seismic waves and seismographs, Elastic rebound theory, Mercelli’s scale of intensity, Magnitude - Richter’s scale and Earthquake Zones in India -Engineering Considerations.</td></tr>
<tr><td>UNIT – V</td><td colspan="6">GEOLOGICAL INVESTIGATIONS FOR ENGINEERING STRUCTURES AND GEOHAZARDS</td><td colspan="2">9 Periods</td></tr>
<tr><td colspan="9">Geological investigations pertaining to the constructions of Dam and Reservoir, Tunnels and Road cuttings, Geophysical investigations - Seismic and electrical resistivity methods and data interpretation. Landslides – causes and prevention – Sea erosion and coastal protection, Tsunami – causes and mitigation. Case studies from India.</td></tr>
<tr><td colspan="9">Contact Periods: Lecture: 45 Period Tutorial: 0 Period Practical: 0 Period Total: 45 Periods</td></tr>
</table>

TEXT BOOKS:

1	*Parbin Singh, “**Engineering and General Geology**”, Katson Publication House, 2015.*
2	*Varghese, P.C., “**Engineering Geology for Civil Engineering”** PHI Learning Private Limited,New Delhi, 2012.*

REFERENCES:

1	*F.G.Bell. “**Fundamentals of Engineering Geology”**, B.S. Publications. Hyderabad 2011.*
2	*N. Chenna Kesavulu. “**Textbook of Engineering Geology”**, Macmillan India Ltd., 2009.*
3	*A.B.Roy , “**Fundamentals of Geology**”, Narosa Publication,2010.*
4	*S.M.Mathur, “**Elements of Geology**”, PHI learning private limited New Delhi 2011.*
5	*Bangar.K.M, “**Principles of Engineering Geology**”, Standard Publishers& Distributors,1705- B, Naisarak, Delhi,2010.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonom yMapped
CO1	Know the internal structure of earth and its relation to volcanism and the various geological agents.	K2
CO2	Identify the properties and uses of Minerals.	K1
CO3	Identify the formation and Engineering properties of rocks.	K2
CO4	Apply fundamental knowledge in structural geology like fault, fold and Joints	K3
CO5	Use all the geological knowledge in design and construction of major civil engineering structures, in addition to mitigating geological hazards such as earthquakes, landslides and Tsunami that affect civil engineering structures.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	1	-	-	-	-	-	1	2	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	2	-	-	-	-	1	-	-	-	3	-	-	1	2	-
CO4	-	1	-	3	-	1	1	2	-	3	1	1	1	2	-
CO5	-	1	1	3	1	2	2	2	-	1	1	1	1	2	-
22CES 308	2	1	1	3	1	1	1	2	-	3	1	1	1	2	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.2.2,1.4.1,2.1.2,3.1.1,7.1.1,7.1.2
CO2	1.3.1,1.2.1,2.1.2,2.2.2,3.1.1,7.1.1,7.1.2
CO3	1.2.1,2.1.2, 2.2.2,3.1.1, 3.1.5, 6.1.1,6.2.2,7.1.1, 7.1.2
CO4	1.3.1,2.1.2,3.1.5 ,6.1.1,6.2.2,7.1.1,7.1.2,7.2.2,9.1.1
CO5	1.3.1,1.4.1,2.1.2,3.1.1,6.1.1,6.2.2,7.1.1, , 7.1.2,7.2.2,9.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Rememberin g (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluatin g (K5) %	Creating (K6) %	Total %
CAT1	50	50					100
CAT2	40	40	20				100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	40	40	20				100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	40	40	20				100
ESE	40	40	20				100

22CPC301	MECHANICS OF SOLIDS I					SEMESTER III
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
ENGINEERING MECHANICS		**PC**	**3**	**0**	**0**	**3**
Course Objectives	To understand the concepts and the behavior of Engineering materials under the action of axial, bending and twisting forces in order to evaluate the strength of the materials.					
UNIT – I	**STRESS, STRAIN AND DEFORMATION OF SOLIDS**					**9 Periods**
Introduction – Mechanical properties of materials – Hooke's law – Stress Strain Diagram for Mild Steel, TOR Steel, Concrete – Principle of superposition - Deformation of simple, compound bars and bars of Varying sections – Elastic constants - Volumetric strains – Thermal Stresses and Strains - Strain Energy due to Axial Force – Resilience – Stresses due to Impact and Suddenly Applied Load. Stresses and deformation in thin cylindricalshell due to internal pressure.						
UNIT – II	**SHEAR FORCE AND BENDING MOMENT IN BEAMS**					**9 Periods**
Beams and Bending – supports and loads - Shear Force and Bending Moment Diagrams for determinate beams – Relationship between Rate of Loading, Shear Force, Bending Moment – Point of Contra Flexure.						
UNIT – III	**BENDING AND SHEAR STRESSES IN BEAMS**					**9 Periods**
Theory of Simple Bending – Analysis of Beams for Stresses - Stress Distribution at a Cross Section due to Bending Moment and Shear Force for determinate beams - Flitched Beams – Combined Direct and Bending Stresses – Condition for No Tension in a section – Strain Energy due to Flexure, Transverse Shear – Shear Stress Distribution.						
UNIT – IV	**TORSION**					**9 Periods**
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Strain Energy due to Torsion – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – springs in series and parallel.						
UNIT – V	**COMPLEX STRESSES AND TRUSS**					**9 Periods**
State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress–Principal Strains and Direction – Mohr's circle method. Analysis of pin jointed plane determinate trusses by method of joints and method of sections – Analysis of space truss by tension coefficient method.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*Rajput R.K. "**Strength of Materials (Mechanics of Solids**", S.Chand & company Ltd., New Delhi, 7th edition, 2018.*
2	*Rattan S.S., "**Strength of Materials**", Tata McGraw Hill Education Pvt .Ltd., New Delhi, 2017.*

REFERENCES:

1	*Singh. D.K., "**Strength of Materials**", Ane Books Pvt Ltd., New Delhi, 2021.*
2	*Egor P Popov, "**Engineering Mechanics of Solids**", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2015.*
3	*Beer. F.P. & Johnston. E.R. "**Mechanics of Materials**", Tata McGraw Hill, 8th Edition, New Delhi 2019.*
4	*Vazirani. V.N, Ratwani. M.M, Duggal .S.K **"Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1"**, Khanna Publishers, New Delhi 2014.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the fundamental concepts of stress, strain and their deformations under axial loads.	K2
CO2	Draw shearforceandbending momentdiagrams for different loadings on the determinate beams	K3
CO3	Sketch the distribution of stresses for various cross sections subjected to transverse loadings.	K3
CO4	Apply elastic theory of torsion in designing of shafts and helical springs.	K3
CO5	Analyse the determinate trusses and 2D stress elements.	K3

22CPC302	CONSTRUCTION MATERIALS AND TECHNOLOGY		SEMESTER III			
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**PC**	**2**	**0**	**2**	**3**

Course Objectives	To learn the properties, applications and testing procedures of construction materials and the construction practices for different types of structural elements.	
UNIT – I	**CONSTRUCTION MATERIALS**	**6 periods**
Properties, composition, types & tests : Stones – Bricks – Timber – Wood products – Glass - Polymer products.		
UNIT – II	**MASONRY AND PLASTERING**	**6 periods**
Stone masonry – Brick masonry –- Composite masonry– Types of wall - Lintels. Plastering–Materials and Methods of plastering–Types of plastering - Defects in plastering–pointing.		
UNIT – III	**FLOORING AND ROOFING**	**6 periods**
Floors– Floor finishing materials – Classifications – Terrazzo flooring – Cement concrete flooring – Damp Proof Course – Causes and effect of dampness – Materials and Methods of damp proofing – Anti-termite treatment. Roofs – Roofing materials –Types – Pitched roof –Flat roof – Flat and Ribbed slab. Ramps and Escalators.		
UNIT – IV	**DOORS,WINDOWS AND PAINTING**	**6 periods**
Doors and Windows – Types – Fixtures and Fastening – Ventilators. Painting – Classification of paints – Painting on new and old surfaces of steel, timber and masonry wall.		
UNIT – V	**CONSTRUCTION PRACTICES**	**6 periods**
Centering and shuttering – Formwork – Scaffolding – Plumbing Services. Erection of steel trusses – Frames – Launching girders – Automation in construction.		

LIST OF EXCERCISES **30 periods**

1. Identification and classification of stone materials.
2. Crushing and water absorption test on stone as per Indian code.
3. Compression test on hollow block.
4. Hands on practice for arrangement of different brick masonry bonds (Demonstration for practice and drawing for exam)
5. Hand's on practice on plastering works.
6. Collection of different flooring material from the field / laying of floor tiles.
7. a) Different types of roof & application – case study
   b) Study on the types of roof selection and its material for different applications.
8. Identification and classification the different types of doors and window in the campus, discussing its feature.
9. Classification of paints & utilization as per current market (inner & outer).
10. a) Observation and plot the existing plumbing service inside the campus.
    b) Study on the different plumbing services and its appliances.
11. Case study on recent technologies used in construction.

Contact Periods: **Lecture: 30 Periods** **Tutorial: 0** **Practical: 30 Periods** **Total: 30 Periods**

TEXT BOOKS:

1	*Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain,* ***"Building construction"****, Laxmi Publications Pvt. Ltd.,2016.*
2	*Bindra.S.P and Arora.S.P ,****"Building construction"****, Dhanpat Rai Publication Pvt. Ltd.,2010.*

REFERENCES:

1	*Edward Allen, Joseph Iano,* ***"Fundamentals of Building Construction: Materials and Methods"****, Wiley Publishers,2014.*
2	*Maden Mehta,* ***"Building Construction"****, Pearson Education Publishers, 2016.*
3	*Varghese P.C,* ***"Building Construction"****, Prentice Hall of India,2012.*
4	*Rangwala,* ***"Building construction"****, Charotar Publishing House Pvt. Ltd., 2016.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Select the suitable materials for building construction	K2
CO2	Outline the different types of masonry and plastering works.	K2
CO3	Select the suitable type of floors, roofs, stairs and dampness preventing methods for practical applications.	K2
CO4	Apply knowledge to select suitable doors, windows and paints for buildings.	K2
CO5	Summarize the different construction practices existing in construction field.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
CO1	3	2	1	1	0	3	3	3	2	2	0	3	2	2	2
CO2	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO3	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO4	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO5	3	2	1	1	1	3	3	3	3	2	0	3	2	1	2
22CP C302	3	2	1	1	1	3	3	3	3	2		3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO2	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO3	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 1
CO4	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO5	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60					100
CAT2	40	60					100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	60					100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	60					100
ESE	40	60					100

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	0	3	3	3	2	2	0	3	2	2	2
CO2	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO3	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO4	3	1	1	1	0	3	3	3	2	2	0	3	2	1	2
CO5	3	2	1	1	1	3	3	3	3	2	0	3	2	1	2
22CPC3 02	3	2	1	1	1	3	3	3	3	2	0	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO2	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO3	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO4	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3
CO5	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 12.1, 12.2, 12.3

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	60					100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	60					100
ESE	40	60					100

22CPC303	SURVEYING	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To understand the basic principle and concepts of different surveying methods to calculate various measurements using survey instruments.	
UNIT – I	**INTRODUCTION, CHAIN SURVEYING AND COMPASS SURVEYING**	**9 Periods**
Definition- Principles - Classification – Field and Office work – Scales – Conventional Signs. Chain Survey - Instruments – Ranging – Types - Obstacles in Chaining – Chain and Tape corrections –Setting out Perpendiculars. Prismatic Compass – Surveyor's Compass – Working and use of compass - Bearing – Systems and Conversions – Computation of angles from bearing - Local Attraction - Magnetic Declination – Dip – Traversing – Adjustment of error.		
UNIT – II	**LEVELLING AND CONTOURING**	**9 Periods**
Basic Terms - Types of Level – Fundamental Axes - Levelling staff – Bench Marks – Temporary and Permanent Adjustments – Types of Levelling - Curvature and Refraction correction – Reciprocal Levelling – Calculation of Areas and Volumes. Contouring – Characteristics and Uses of Contours – Methods of contouring.		
UNIT – III	**THEODOLITE SURVEYING AND TACHEOMETRIC SURVEYING**	**9 Periods**
Theodolite – types – Terms - Temporary and Permanent Adjustments – Measurement of Horizontal Angles by Repetition and Reiteration – Closing Error and Distribution – Omitted measurements. Tacheometric surveying –- Stadia method - fixed hair method - Determination of constants of the tacheometer - use of anallactic lens - distance and elevation formula for inclined sights with vertical and normal holding staff – movable hair method - Tangential method - subtense bar method.		
UNIT – IV	**CURVES AND HYDROGRAPHIC SURVEYING**	**9 Periods**
Simple curves – elements - Setting out of curves - Linear and angular methods - Compound and Reverse curves - elements. Shore line survey–Sounding–Equipments–Locating Sounding-Reduction.		
UNIT – V	**TRIANGULATION AND MODERN SURVEYING INSTRUMENTS**	**9 Periods**
Vertical and horizontal control - Triangulation-classification – Intervisibility - Triangulation Figures – Strength of figure -Signals and Towers - Base line measurements - Satellite stations and reduction to centre. Trigonometrical Levelling - Geodetical observations - Curvature correction - Refraction correction – Axis signal correction – Difference in elevation. Total Station – Principle – classification - working. Applications of Drone Surveying. GPS - Developments – Basic Concepts – Segments – Applications.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Punmia B.C, Ashok K Jain, Arun K Jain.* ***"Surveying, Vol. I &II"****, Lakshmi Publications, 2017.*
2	*Kanetkar.T.P,and Kulkarni.S.V,* ***"Surveying and Levelling, Vol. I & II"****, Pune Vidyarthi Griha Prakashan,2014.*

REFERENCES :

1	*Basak N.N,* ***"Surveying and Levelling"****, Tata McGraw-Hill, Publishing Company, 2nd edition,2014.*
2	*BhavikattiS.S,****"Surveying and Levelling,Vol.I&II"****, I.K. International Pvt. Ltd., 2010.*
3	*Duggal S.K.* ***"Surveying,Vol.I&II"****, Tata McGraw-Hill Publishing Company,2017.*
4	*Charles D Ghilani, Paul R Wolf.,* ***"Elementary Surveying"****, Prentice Hall,2012.*
5	*Chandra A.M.,****"Plane Surveying"****, New Age International Pvt. Ltd, 2015.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Calculate linear and angular measurements using compass and chain.	K2
CO2	Interpret level data using different types of levelling techniques and plot contour map by various contouring methods.	K2
CO3	Determine the horizontal distances, vertical distances and area by using theodolite and tacheometer.	K3
CO4	Set out the curves using survey instruments and apply the principles of hydrographic surveying.	K3
CO5	Execute triangulation method, Trigonometric levelling and apply modern surveying principles and techniques.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	3	3	-	-	-	-	-	-	2	1	2	2
CO2	2	3	-	3	3	-	-	-	-	-	-	2	-	2	2
CO3	3	3	-	3	3	-	-	-	-	-	-	2	-	2	2
CO4	3	3	-	3	3	-	-	-	-	-	-	2	1	2	2
CO5	3	3	-	3	3	-	-	-	-	-	-	2	1	2	2
22CPC303	3	3	-	3	3	-	-	-	-	-	-	2	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.2, 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.2, 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.2, 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	40	40	20	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CES309	MATERIALS TESTING LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	To deal with experimental determination and evaluation of mechanical characteristics and behaviour of construction materials and to familiarize experimental procedures and common measurement instruments, equipment and devices.

LIST OF EXPERIMENTS

1. Mechanical properties of mild steel rod as per IS Code 1608 (2005)
2. Mechanical properties of tor steel rod as per IS Code 1786 (2008)
3. Weight per running metre of steel rod
4. Tension and compression test on springs.
5. Test on Bricks: Visual observation, Compression test, Water absorption test and Efflorescence test as per IS 3495-1 to 4 (1992)
6. Hardness test on different metals.
7. Deflection test on simply supported beams (for different metals).
8. Deflection test on cantilever beams (for different metals).
9. Bending test on rolled steel joist
10. Flexure test on tiles
11. Charpy and Izod Impact Test
12. Compression test on Hallow/Concrete Blocks

Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determinethetensilestrength ofmaterials	K3
CO2	Obtain bending properties of structural materials	K3
CO3	Determinethehardness propertiesofthematerials	K3
CO4	Predict the compressive strength of the materials	K3
CO5	Obtaintheimpact andtorsionalstrengthofthematerials	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO 3**
CO1	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-
CO2	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-
CO3	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-
CO4	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-
CO5	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-
22CE S309	2	-	1	3	-	-	-	-	-	-	-	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1 ,3.1.4,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1
CO2	1.3.1,1.4.1 ,3.1.4,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1
CO3	1.3.1,1.4.1 ,3.1.4,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1
CO4	1.3.1,1.4.1 ,3.1.4,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1
CO5	1.3.1,1.4.1 ,3.1.4,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1

22CPC304	SURVEY LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objectives	To deal with different surveying methods and measure the distances, areas using different surveying instruments and also to enable setting out of foundation and curves.

LIST OF EXPERIMENTS

1. Chain Surveying – Open and Closed Traversing
2. Compass Surveying – Intersection method
3. Compass Surveying - Traversing
4. Plane table surveying –Introduction- Intersection method
5. Levelling –Differential Levelling and Fly Levelling
6. Measurement of horizontal angles by Repetition and Reiteration methods.
7. Height and Distance – Single Plane method and Double Plane method.
8. Tacheometric Surveying – Stadia, Tangential method and Subtense bar method
9. Total Station Surveying.
10. Setting out of foundation and Curves

Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Effectively handlethesurveyinginstrumentslikeChain,Compass,planetable,Dumpy level and Theodolite.	K3
CO2	Accurately measuredistances,areas,anglesandlevels using survey instruments.	K3
CO3	Calculate the levels and distances in the field for various works.	K3
CO4	Setout foundations and curves for various Civil Engineering projects.	K3
CO5	Handle and measure using advanced surveying instruments like Total Station.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	2	-	-	-	-	-	-	-	-	1	1	-
CO2	2	-	1	2	1	-	-	-	-	-	-	-	1	1	-
CO3	2	-	1	2	1	-	-	-	-	-	-	-	1	1	-
CO4	2	-	1	2	1	-	-	-	-	-	-	-	1	1	-
CO5	2	-	1	2	1	-	-	-	-	-	-	-	1	1	-
22CPC304	2	-	1	2	1	-	-	-	-	-	-	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1 ,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1.4.3.1
CO2	1.2.1,1.3.1,1.4.1 ,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1.4.3.1,5.1.1
CO3	1.2.1,1.3.1,1.4.1 ,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1.4.3.1,5.1.1
CO4	1.2.1,1.3.1,1.4.1 ,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1.4.3.1,5.1.1
CO5	1.2.1,1.3.1,1.4.1 ,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1.4.3.1,5.1.1

22CES410	APPLIED HYDRAULICS AND FLUID MACHINERY	SEMESTER IV

PREREQUISITES		CATEGORY	L	T	P	C
MECHANICS OF FLUIDS		ES	3	0	0	3
Course Objectives	To understand the performance of pumps and turbines, open channel hydraulics with different types of flow, dimensional analysis and impulse momentum principle for the performance of hydraulics machines.					
UNIT – I	**OPEN CHANNEL FLOW**					**9 Periods**
Uniform flow - Velocity measurement - Manning's and Chezy's formula – Roughness coefficients - Critical depth and critical velocity - Most economical sections - Wide open channel - Specific energy curve - Critical flow - Dynamic equations of gradually varied flow - Assumptions - Characteristics of flow profiles - Draw down and back water curves - Hydraulic jump - Types – Energy dissipation.						
UNIT – II	**DIMENSIONAL ANALYSIS**					**9 Periods**
Units and Dimensions – Dimensional Homogeneity -Rayleigh's and Buckingham methods – Non-dimensional numbers – Model study and Similitude–scale effects and distorted model – Applications of models study.						
UNIT – III	**MOMENTUM PRINCIPLE**					**9 Periods**
Impulse momentum Principle and equation - Impact of Jet – force exerted by a jet on normal, inclined and curved surfaces for stationary and moving vanes- Angular momentum principle - Inlet and outlet velocity triangles – Applications of impulse momentum principle.						
UNIT – IV	**TURBINES**					**9 Periods**
Turbines – Classification – Impulse and Reaction Turbines – Tangential flow, radial flow and axial flow turbines- work done and efficiency - draft tube and cavitation - Selection of Turbines-operating characteristic curves of turbines- Specific speed- Runaway Speed.						
UNIT – V	**PUMPS**					**9 Periods**
Pumps– Classifications of pumps –Centrifugal pump –Work done and Efficiency – Priming - Net positive Suction Head - Cavitation in Pumps - multistage Pumps. Reciprocating pump -Work done and Efficiency - negative slip - air vessels - indicator diagram–Working of Jet Pump and submersible pump.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOK

1	*P.N.Modi and S.N.Seth, **"Hydraulics and Fluid Mechanics, Including Hydraulic Machines"**, Standard Book House, NewDelhi, 2015.*
2	*R.K.Bansal, **"Fluid Mechanics and Hydraulic Machines"**, Laxmi Publications (P) Ltd., NewDelhi,2018.*

REFERENCES

1	*Subramanya K.,**"Flow In Open channels"**, Tata McGraw-Hill Publishing Company,2015.*
2	*S.Ramamurtham and R.Narayanan, **"Hydraulics Fluid Mechanics and Fluid Machines"** Dhanpat Rai Publishing Company(P) Limited, 2014.*
3	*R.K.Rajput,**"A Text Book of Fluid Mechanics and Hydraulic Machines"**, S.Chand and Company, NewDelhi, 2015.*
4	*D.S.Kumar, **"Fluid Mechanics and Fluid Power Engineering"**, S.K.Kataria & Sons, NewDelhi,2012.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Gain in sight knowledge on Open channel hydraulics and to solve practical problems.	K2,K3
CO2	Apply the concepts of dimensional analysis for fluid flow problems	K3
CO3	Apply the impulse momentum principle for the determination of hydrodynamic forces.	K3
CO4	Analyze the performance of turbines and design of turbines.	K3
CO5	Analyze the performance of pumps and design of pumps.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	0	1	0	0	0	0	0	0	0	0	0	2	1
CO2	2	1	0	1	0	0	0	0	0	0	0	0	0	2	1
CO3	2	1	0	1	0	0	0	0	0	0	0	0	0	2	1
CO4	2	1	1	3	0	0	0	0	0	0	0	0	0	2	1
CO5	2	1	1	3	0	0	0	0	0	0	0	0	0	2	1
22CES 410	2	1	1	3	0	0	0	0	0	0	0	0	0	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 4.1.2
CO2	1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 4.1.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.2.3, 2.3.1, 4.1.2
CO4	1.1.1, 1.3.1,2.1.2,2.1.3, 2.3.2, 3.2.2, 3.4.2, 4.1.1, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.3
CO5	1.1.1, 1.3.1, 2.1.2, 2.1.3, 2.3.2, 3.2.2, 3.4.2, 4.1.1, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.3

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30				100
CAT2	20	50	30				100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	20	50	30				100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	20	50	30				100
ESE	20	50	30				100

22CPC405	MECHANICS OF SOLIDS II					SEMESTER IV
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
MECHANICS OF SOLIDS I		**PC**	**3**	**0**	**0**	**3**
Course Objectives	To study the different methods used for beam deflection analysis, analysis of Indeterminate beams, unsymmetrical bending, columns, theory of elastic failures and stress in thick cylinders.					
UNIT – I	**DEFLECTION OF BEAMS**					**9 Periods**
Differential Equation for elastic curve – Double Integration Method – Macaulay's Method – Moment Area Method – Conjugate Beam Method – Stepped beams						
UNIT – II	**STATICALLY INDETERMINATE BEAMS**					**9 Periods**
Propped Cantilever Beams – Fixed Beams – Method of Consistent Deformation – Continuous Beams – Theorem of Three Moments – Calculation of reactions, Bending Moments and Shear Force – Shear Force and Bending Moment Diagrams (for all Types of Loadings, Couple).						
UNIT – III	**INDETERMINATE TRUSSES AND COLUMNS**					**9 Periods**
Analysis of Plane trusses with maximum two redundant members – Trusses with lack of fit – Temperature effects. Members Subjected to Axial Load – eccentric load – Slenderness Ratio – End Conditions – Buckling Load for Columns - Euler's Theory – Assumptions and Limitations – Rankine - Gordon Formula – Empirical Formula – Straight Line Formula – Columns Subjected to Eccentric Loading .						
UNIT – IV	**UNSYMMETRICAL BENDING AND SHEAR CENTRE**					**9 Periods**
Stresses due to Unsymmetrical Bending of Beams for Symmetrical Sections – Moment of Inertia – Product of Inertia – Principal Moment of Inertia - Shear Centre - Definition – Shear Centre for Sections Symmetrical about One Axis						
UNIT – V	**THICK CYLINDERS AND THEORIES OF ELASTIC FAILURE**					**9 Periods**
Lame's Equation – Hoop Stress and Radial Stress Distribution – Compound Cylinders – Wire Wound Cylinders – Shrink Fit. Theories of Elastic Failure – Factor of Safety – Graphical Representation of Theories for Two Dimensional Stress System.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical:0 Periods Total:45 Periods**						

TEXT BOOKS:

1	*Vaidyanathan.R, Perumal. P and Lingeswari.S, "**Mechanics of Solids and Structures, Volume I**", Laxmi Publications Pvt Ltd, Chennai, 2017.*
2	*L.S.Negi, "**Strength of Materials**", Tata McGraw Hill Education Pvt.Ltd, 2010.*

REFERENCES:

1	*Robert L. Mott, **"Applied Strength of Materials"**, PHI Learning Pvt Ltd., New Delhi,2009*
2	*Ferdin and Beer, E.Russell Johnston and John Dewolf, **"Mechanics of Materials"**, McGraw Hill Education, 2015.*
3	*L.S. Srinath, **"Strength of Materials",**Macmillan Publishers India,2000.*
4	*Bansal RK **"Strength of Materials"**, Laxmi Publications, New Delhi,2010.*
5	*Jhunarkar.S.B. and Shah.H.J, **"Mechanics of Structures",** Vol. I, Charotar Publishing House, New Delhi,2016.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To impart knowledge on deflection of beams in various situations using different methods.	K3
CO2	To identify the behaviour of statically indeterminate beams	K3
CO3	To recognize the behaviour of columns with different end conditions.	K3
CO4	To develop and understand the concepts of unsymmetrical bending of beams and shear centre.	K3
CO5	To understand the theory thick cylinders and the theory of elastic failures.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	-	-	-	1	-	-	-	1	1	-
CO2	3	3	2	2	-	-	-	-	1	-	-	-	-	2	-
CO3	3	2	2	1	1	-	-	-	1	-	-	-	1	-	-
CO4	3	1	2	1	-	-	-	-	1	-	-	-	1	1	-
CO5	3	1	2	-	-	1	-	-	1	-	-	-	-	1	-
22CPC405	3	2	2	1	1	1	-	-	1	-	-	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.3.3, 4.3.4, 5.2.1, 5.2.2, 6.1.1, 9.1.2
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.3.3, 4.3.4, 5.1.1, 5.2.1, 9.1.2
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.2.3, 3.4.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.1.2
CO4	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.3.1, 2.4.1, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 9.1.2
CO5	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.3.2, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.2.1, 4.3.2, 4.3.3, 4.3.4, 5.2.1, 5.3.1, 9.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30				100
CAT2	20	40	40				100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	30	40	30				100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	20	40	40				100
ESE	30	40	30				100

22CPC406	CONCRETE TECHNOLOGY					SEMESTER IV
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
CONSTRUCTION MATERIALS AND TECHNOLOGY		**PC**	**3**	**0**	**0**	**3**
Course Objectives	To understand about various concrete making materials, the properties of fresh and hardened concrete, special concrete and mixdesignforconcrete.					
UNIT – I	**INGREDIENTSOFCONCRETE**					**9 periods**
Cement – constituents - Hydration – Tests on cement – Types of cement – Aggregates – properties and uses – Classification of aggregates – Properties and test on aggregates – gradation – Quality of water – Admixtures – Chemical Admixtures and mineral admixtures.						
UNIT – II	**CONCRETING OPERATIONS**					**9 periods**
Concreting operations: Batching, mixing, transportation, placing, compaction, curing and finishing of concrete. Forms for Concreting: Different types of formworks for beams, slabs, columns, material used for formwork, requirement of good form work. Stripping time for removal of formworks as per IS456 – 2000 provision for different structural members. Water Proofing: Importance and need of water proofing. Methods of water proofing and materials used for water proofing. Joints in Concrete Construction: Types of joints, joining old and new concrete. Methods of joining, materials used for filling joints.						
UNIT – III	**PROPERTIESOFCONCRETE**					**9 periods**
Properties of fresh concrete – Workability – Segregation – Bleeding – Test for fresh concrete properties – Properties of hardened concrete – Strength – Stress – Strain characteristics – Modulus of Elasticity – Shrinkage – Creep – Thermal properties – Permeability – Test for hardened concrete properties – Introduction to micro structural properties of concrete - Non-Destructive Test.						
UNIT – IV	**MIX DESIGN AND QUALITYCONTROLOFCONCRETE**					**9 periods**
Quality Control - Frequency of sampling – Statistical analysis of test results – standard deviation – Coefficient of variation – Characteristic strength – Acceptance and rejection Criteria – Importance ofwater cement ratio – Importance of cover to concrete. Nominal mixes – Design Mixes – factors influencing the design mix – Mix Design by ACI method, ARE method and DOE method.						
UNIT – V	**SPECIALCONCRETES AND CONCRETING METHODS**					**9 periods**
High Performance Concrete – Lightweight Concrete – Self Compacting Concrete – Polymer Concrete – Fibre Reinforced Concrete - 3D printing of concrete. Special Concreting Methods: Pumped Concrete, Ready mix Concrete, Under-water Concrete, Hot and Cold weather Concreting, Precast Concrete, Pre-placed Concrete.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*Shetty M.S and Jain A.K, **“Concrete Technology - Theory and Practice”**, S.Chand & Company, New Delhi, 2018.*
2	*Santha kumar A.R ,**“Concrete Technology”**,S.Chand Publishers, 2018.*

REFERENCES:

1	*Gambhir M.L, **“Concrete Technology - Theory and Practice”**, Tata Mc-Graw Hill Company,2013.*
2	*IS 10262 –2019, Concrete Mix Proportioning – Guidelines.*
3	*ACI 211.1-91, Standard Practicefor Selecting Proportions for Normal, Heavy weight and Mass Concrete, American Concrete Institute.*
4	*NevilleA.M **“Properties of Concrete”**, Pearson Education India,,2012*
5	*Povindar K. Mehta, Paulo J. M. Monteiro, **“Concrete: Microstructure, Properties, and Materials”**, Mc-Graw Hill Company, 2014.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the properties and role of ingredients like cement, aggregate, admixtures in concrete.	K2
CO2	Choose the suitable formwork and methods of concrete production for construction.	K2
CO3	Infer the behavior of fresh and hardened concrete.	K2
CO4	Proportion the concrete using various mix design concepts.	K2
CO5	Select appropriate type of concrete for specific requirements.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	0	3	3	3	2	3	0	3	2	3	2
CO2	3	1	1	1	0	3	3	3	3	3	0	3	2	3	2
CO3	3	1	1	1	0	3	3	3	2	2	0	3	2	2	1
CO4	3	1	1	1	0	3	3	3	2	3	1	3	2	2	1
CO5	3	2	1	1	1	3	3	3	2	2	1	3	2	3	2
22CPC406	3	2	1	1	1	3	3	3	3	3	1	3	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 11.2, 12.1, 12.2, 12.3
CO2	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 11.2, 12.1, 12.2, 12.3
CO3	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 11.2, 12.1, 12.2, 12.3
CO4	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 11.2, 12.1, 12.2, 12.3
CO5	1.2, 1.3, 1.4, 2.1, 2.2, 2.4, 3.1, 3.2, 3.4, 4.1, 4.3, 6.1, 6.2, 7.1, 7.2, 8.1, 8.2, 9.1, 9.2, 10.1, 10.2, 10.3, 11.2, 12.1, 12.2, 12.3

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60					100
CAT2	40	60					100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	40	60					100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	40	60					100
ESE	40	60					100

22CPC407	DESIGN OF REINFORCED CONCRETE ELEMENTS	SEMESTER IV

PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
MECHANICS OF SOLIDS I		**PC**	**3**	**0**	**0**	**3**
Course Objectives	Understand the behavior and design of reinforced concrete components and systems subjected to gravity loads according to INDIAN STANDARD building code requirements					
UNIT – I	**REINFORCEDCONCRETEMATERIALS**					**9 Periods**
Introduction to R.C structures – Review of basic material properties - Concrete and Reinforcing steel - Objectives of structural Design- Stages in RCC structural design process for a building- Types of load on structures and load combinations –Load transfer in framed structures - Design philosophies – Basic design concepts –working stress, ultimate load and limit state methods – Analysis: Moment of resistance for Rectangular beams.						
UNIT – II	**LIMIT STATE DESIGN OF BEAMS**					**9 Periods**
Design of singly and doubly reinforced rectangular and flanged beams - Design of beams for bending, shear and torsion - bond and anchorage – deflection.						
UNIT – III	**LIMIT STATE DESIGN OF SLABS& STAIRS**					**9 Periods**
Behaviour of one way and two way slabs – Design and detailing of one way and two way rectangular slabs subjected to uniformly distributed load - Design of lintel - lintel cum sunshade – Stairs - Loads on Staircase – Design of Dog legged staircase.						
UNIT – IV	**LIMIT STATE DESIGN OF COLUMNS**					**9 Periods**
Classification of columns - Axial, uniaxial and biaxial bending - Braced and unbraced columns - Orientation of columns in buildings - Design of columns – Use of interaction charts.						
UNIT – V	**LIMIT STATE DESIGN OF FOOTINGS**					**9 Periods**
Behaviour of concentric and eccentric footing - Design of axially loaded square and rectangular pad and sloped isolated footing – Design of wall footing.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*Pillai, S. U.andMenon, D,**"Reinforced Concrete Design"**, Tata McGraw Hill, 2021*
2	*SubramanianN, **"Design of Reinforced Concrete Structures"**, Oxford University Press, 2014.*

REFERENCES:

1	*VarghesePjC, **"Limit State Design of Reinforced Concrete"**, Prentice hall of India Pvt.Ltd., 2008*
2	*Dayaratnam P., **"Design of Reinforced Concrete Structures"**, Oxford & IBH publishing Co. Pvt.Ltd.,2018.*
3	*Shah V.L and Karve S.R, **"Limit State Theory and Design of Reinforced Concrete"**, Structures Publications, 2018.*
4	*Krishnaraju N, **"Design of Reinforced Concrete Structures"**, CBS Publishers and Distributors PvtLtd, 2019.*
5	IS: 456-2000 (R2016), "***Plain and Reinforced Concrete - Code of practice"***.
6	SP: 16-1980, "***Design Aids for Reinforced Concrete to IS 456:(1978)"***.
7	IS: 875-2015, "***Code of Practice for design loads for buildings and structures***".
8	SP: 34-1987, "***Handbook on Concrete Reinforcement and Detailing***".

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Apply theconceptsofworkingstress method andlimitstatemethods and estimate the design loads on various structural elements.	K2
CO2	Analyse and Designthe beams using Limit State Method.	K3
CO3	Designofrectangularslabsandstaircasesbylimitstatemethod and prepare detailing drawing.	K3
CO4	Designthecolumnssubjectedtobothaxialandeccentricloads	K3
CO5	Designloadedwallandisolatedfootings.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	--	2	--	--	--	1	--	--	--	--	--
CO2	2	2	1	1	--	2	--	--	1	1	--	--	--	2	2
CO3	2	2	1	1	--	2	--	--	1	1	--	--	--	2	2
CO4	2	2	1	1	--	2	--	--	1	1	--	--	--	2	2
CO5	2	2	1	1	--	2	--	--	1	1	--	--	--	2	2
22CPC 407	2	2	1	1	--	2	--	--	1	1	--	--	--	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2, 6.2.1, 10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPC408	WATER SUPPLY ENGINEERING	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To conversant with sources of water, demand of water, characteristics of water and Conveyance of Water.To expose the students to understand the design of water Treatment processes and distribution of water supply	
UNIT – I	**QUANTITY OF WATER AND SOURCES OF WATER**	**9 Periods**
Introduction of Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater –Impounding Reservoir – Development and selection of source – Source Water quality.		
UNIT – II	**QUALITY OF WATER AND TRANSPORTATION**	**9 Periods**
Quality of water - sampling - Characterization – Significance -analysis of water - water borne diseases - quality standards of water as per IS 10500. Intakes - types - intake tower - Transportation of water - types of conduits - Hydraulics of pipe flow - design - materials of pressure pipes - pipe corrosion - Theories, effect and prevention- Laying, jointing and testing of pipe lines. Pumps - Types of pumps - pumping stations.		
UNIT – III	**WATER TREATMENT**	**9 Periods**
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators, flash mixers, Coagulation and flocculation – Clarifloccuator - Plate and tube settlers - Pulsator clarifier –Rapid and slow sand filters - Disinfection - Residue Management –Construction, Operation and Maintenance of treatment units- Recent advances.		
UNIT – IV	**ADVANCED WATER TREATMENT**	**9 Periods**
Water softening - Desalination - R.O. Plant - demineralization – Adsorption - Ion exchange - Membrane Systems - RO Reject Management - Iron and Manganese removal –Fluoridation and Defluoridation - Construction , Operation and Maintenance of treatment units – Recent advances.		
UNIT – V	**WATER DISTRIBUTION SYSTEM**	**9 Periods**
Distribution of water - requirements of good distribution system - method of distribution system - layouts of distribution system - Requirements of water distribution – Components – Selection of pipe material – Service reservoirs – Functions – Network design – Analysis of distribution networks - Computer applications – Appurtenances – Leak detection. Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Garg. S. K., "**Water Supply Engineering**", Khanna Publishers, Delhi, 2014.*
2	*Punmia B.C, Jain A.K and Jain A.K, "**Water Supply Engineering**" Laxmi Publications, New Delhi 2014.*

REFERENCES :

1	*Dr. P.N. Modi., "**Water Supply Engineering Volume**" Rajson Publications, New Delhi, 2018.*
2	*D. Lal&A.K. Upadhyay, "**Water Supply and Waste Water Engineering**" S. K. Kataria& Sons, 2013*
3	*Mackenzie L Davis., "**Water and Waste Water Engineering Design Principles and Practice**", McGraw Hill book education, 2010.*
4	*NPTEL "**Water and Waste Water Engineering**" by Dr.P.Bose , IIT Kanpur.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Know the principles of water supply and characteristics of water.	K1, K2
CO2	Attain knowledge on quality of water and its conveyance.	K1, K2
CO3	Acquire knowledgeon various water treatment units.	K1, K2
CO4	Get clear knowledge about advanced water treatments	K1, K2
CO5	Know the distribution and supply of water	K1, K2

COURSE ARTICULATION MATRIX:

	a) CO and PO Mapping													
COs/ POs	**PO 1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1				1	2						1	2	2
CO2	2	2	1			1	2						2	2	2
CO3	2	1	2			1	2						2	2	2
CO4	1	2	2			1	2						2	2	2
CO5	1	1	1			1	2						2	2	2
22CP C408	2	2	2			1	2						2	2	2
	1 – Slight, 2 – Moderate, 3 – Substantial														
	b) CO and Key Performance Indicators Mapping														
CO1	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3,6.1.1,7.1.1,7.1.2,7.2.2														
CO2	1.2.1, 1.3.1,1.4.1, 2.1.3,2.2.3, 2.3.1, 2.4.3,3.1.4, 3.1.6,3.3.1, 6.1.1, 7.1.1,7.1.2,7.2.2														
CO3	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3,, 3.1.4, 3.1.6,3.3.1,3.2.3, 6.1.1, 7.1.1,7.1.2,7.2.2														
CO4	1.2.1, 1.3.1,1.4.1, 2.1.3,2.2.3, 2.3.1, 2.4.3, 3.1.4, 3.1.6, 3.2.3,3.3.1, 5.1.1, 6.1.1, 7.1.1,7.1.2,7.2.2														
CO5	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3, 3.1.4, 3.1.6,3.3.1, 6.1.1, 7.2.2, 7.1.1,7.1.2,7.2.2														

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60					100
CAT2	40	60					100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	60					100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	60					100
ESE	40	60					100

22CMC4Z2	**CONSTITUTION OF INDIA** (Common to all Branches)	**SEMESTER IV**			
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**MC**	**3**	**0**	**0**	**0**

Course Objectives	The objective of the course is to familiarize the students on the role,powers and functions of Indian government. Also understand the recent acts in India.	
UNIT- I	**INTRODUCTION ANDEMERGENCY PROVISIONS**	**9 Periods**
Historical Background: The Company rule, The Crown rule - Constituent Assembly: Composition, Objectives - Preamble and Salient features of the Indian Constitution - Fundamental Rights, Fundamental Duties, Directive Principles of state policy, Emergency Provisions - National Emergency, President Rule, Financial Emergency.		
UNIT- II	**SYSTEM OF GOVERNMENT**	**9 Periods**
Parliamentary system: merits, demerits, reasons for adopting parliamentary system – Federal system: Evaluation of federal features –Centre-State relations: Legislative, Administrative and Financial relations – Local Government: Panchayati Raj and urban local government.		
UNIT- III	**UNION AND STATE GOVERNMENT**	**9 Periods**
President of India: Election, Powers and functions - Prime Minister and Cabinet: Structure and functions – Governor: Powers and functions - Chief Minister and Council of Ministers: Functions.		
UNIT- IV	**ORGANS OF GOVERNANCE AND RECENT ACTS**	**9 Periods**
Parliament: LokSabha and RajyaSabha, Composition and powers - State Legislative Assembly and Legislative Council: Composition and powers - Judicial System in India: Structure and features - Supreme Court and High Court: Composition, Jurisdiction, Recent acts in significance-RTI, Citizenship act, POCSO Act.		
UNIT- V	**POLITICAL DYNAMICS**	**9 Periods**
Political parties: Party system, Recognition of National and State parties – Elections: Electoral system and reforms – Pressure groups – National Integration: Obstacles, National Integration Council – Foreign Policy: Principles and Objectives.		
Contact Periods: **Lecture: 45 Period Tutorial: 0 Period Practical: 0 Period Total: 45 Periods**		

TEXT BOOKS:

1	*National portal of India, "**The Constitution of India**" (Full Text), https://legislative.gov.in/constitution-of-india*
2	*Dr.B.R.Ambedkar, "**The Constitution of India",** Sudhir Prakashan, 2020.*

REFERENCES:

1	*Durga Das Basu, "**Introduction to the Constitution of India**, LexisNexis, 2022*
2	*P.M.Bakshi, "**The Constitution of India"**, LexisNexis, 2020*
3	*Subash C Kashyap, "**Our Parliament"**, National Book Trust, 2021*
4	*Subash C Kashyap, "**Our Political System**", National Book Trust, 2011*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Know the evolution of Indian Constitution and its basic premises.	K1
CO2	Explain the system of governance in India.	K2
CO3	Describe the structure of Union and State Governments	K2
CO4	Obtain the knowledgeof functions of Legislature and Judiciary	K1
CO5	Know the political system of India	K1

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	1	-	1	1	-	-	-	-	-	1
CO3	-	-	-	-	-	2	-	1	1	-	-	-	-	-	1
CO4	-	-	-	-	-	1	-	1	2	-	-	-	-	-	1
CO5	-	-	-	-	-	2	-	2	1	-	-	-	-	-	-
22CMC4Z 2	-	-	-	-	-	1	-	1	1	-	-	-	-	-	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	6.1.1,6.2.1,8.1.1,8.2.1,8.2.2,9.1.2
CO2	6.1.1,6.2.1,8.1.1,8.2.1,8.2.2,9.1.2
CO3	6.1.1,6.2.1,8.1.1,8.2.1,8.2.2
CO4	6.1.1,6.2.2,9.1.2,9.2.1
CO5	6.2.2,8.1.1,8.2.2,9.1.2,9.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Rememberin g (K1) %	Understandin g (K2) %	Applyin g (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creatin g (K6) %	Total %
CAT1	50	50	-	-	-	-	100
CAT2	50	50		-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-			-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-			-	100
ESE	50	50	-	-	-	-	100

22CES411	FLUID MECHANICS AND MACHINERY LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
MECHANICS OF FLUIDS	ES	0	0	3	1.5

Course Objectives	* To impart knowledge in solving problems occurring in a pipes due to losses, the verification of Bernoulli's theorem and its applications and conducting performance tests on different types of pumps and turbines.

LIST OF EXPERIMENTS:

1. Determination of Darcy's friction factor.
2. Verification of Bernoulli's Theorem.
3. Calibration of Venturimeter and Orifice meter.
4. Flow over V-Notch.
5. Flow through Mouthpiece.
6. Determination of velocity through Pitot tube.
7. Determination of Meta centric height.
8. Performance Study of Roto dynamic pumps:Centrifugal pump, Submersible pump and Jet pump.
9. Performance Study of Positive displacement pumps:Reciprocating pump, Gear oil pump and Single screw pump.
10. Load test on Pelton wheel, Francis turbine and Kaplan Turbine.

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Obtain the knowledge on conducting different type of experiments.	K2
CO2	Solve different problems in pipes due to losses.	K3
CO3	Verify the Bernoulli's theorem and its applications.	K3
CO4	Do performance tests on different types of pumps.	K3
CO5	Do performance tests on different types of turbines.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1
CO2	2	2	0	2	1	0	1	0	0	0	0	0	0	2	1
CO3	1	2	0	2	0	0	0	0	0	0	0	0	0	2	1
CO4	0	1	0	2	1	0	1	0	0	0	0	0	0	2	1
CO5	0	1	0	2	1	0	1	0	0	0	0	0	0	2	1
22CES 411	2	2	0	2	1	0	1	0	0	0	0	0	0	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.3.2, 2.4.2
CO2	1.1.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.2, 4.1.3, 4.1.4, 4.3.1, 5.2.1, 5.3.2, 7.1.1
CO3	1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1
CO4	2.1.2, 2.1.3, 2.3.1, 2.4.2, 4.1.3, 4.2.1, 4.3.1, 4.3.3, 5.2.1, 5.3.2, 7.1.1
CO5	2.1.2, 2.1.3, 2.3.1, 2.4.2, 4.1.3, 4.2.1, 4.3.1, 4.3.3, 5.2.1, 5.3.2, 7.1.1

22CES412	ENGINEERING EXPLORATION FOR CIVIL ENGINEERING				SEMESTER IV
PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**ES**	**0**	**0**	**3**	**1.5**

Course Objectives	The objective of the course is to provide an introduction to the engineering field. It is designed to help the student to learn about engineering and how it is useful in our everyday life.	
UNIT- I	**INTRODUCTION**	**(15)**
Introduction to Engineering and Engineering study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, expectation for the 21st century engineer and Graduate Attributes.		
UNIT- II	**ENGINEERING DESIGN**	**(15)**
Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements, Problem definition, Idea generation through brain storming and researching, solution creation through evaluating and communicating, text/analysis, final solution and design improvement.		
UNIT- III	**ENGINEERING DISCIPLINES**	**(15)**
Civil Engineering: Loads on Structures, Analysis of Structural elements, Design and detailing of Structural elements. Testing and selection of construction materials. Analysis of water quality and checking its suitability for construction and drinking purposes. Preparation of site layout using advanced Survey instruments. Modeling of Hydraulic elements.		
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Practical: 45 Periods Total: 45 Periods**		

REFERENCES:

1	*Ryan A Brown, Joshua W. Brown and Michael Berkihiser: "**Engineering Fundamentals: Design, Principles and Careers**", Goodheart-Willcox Publisher, Second edition, 2014.*
2	*Saeed Moaveni, "**Engineering Fundamentals: An Introduction to Engineering**", Cengage learning, Fourth Edition, 2011.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain technological and engineering development , change and impacts of engineering	K2
CO2	Complete initial steps (Define a problem list criteria and constrains , Brainstorm potential solutions and document ideas) in engineering designs	K3
CO3	Communicate possible solutions through drawings and prepare project report.	K3
CO4	Draw sketches to a Design problem.	K3
CO5	Apply the concept of engineering fundamentals in Civil, Mechanical, Electrical and Computer Engineering.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	0	0	0	0	0	0	0	0	0	0	2	-
CO2	3	2	1	0	0	0	0	0	0	0	0	0	0	1	1
CO3	3	2	1	0	0	0	0	0	0	0	0	0	0	2	-
CO4	3	2	1	0	0	0	0	0	0	0	0	0	0	1	-
CO5	3	2	1	0	0	0	0	0	0	0	0	0	0	1	1
22CES412	3	2	1	0	0	0	0	0	0	0	0	0	0	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 2.2.4, 6.1.1, 7.1.1, 7.2.1
CO2	2.1.1, 2.2.3, 3.1.1, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 4.1.1, 4.1.2, 4.2.2
CO3	2.1.3, 3.2.1, 3.2.2, 3.2.3, 3.4.2, 4.3.2, 4.3.3, 4.3.4, 9.2.1, 9.3.1, 10.1.3, 10.2.2, 10.3.2, 11.3.2
CO4	3.1.3, 5.1.1, 5.2.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 4.3.1, 7.2.2, 8.2.2, 9.1.2, 10.1.1, 11.3.2

22CPC409	ENVIRONMENTAL ENGINEERING LABORATORY					SEMESTER IV
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**PC**	**0**	**0**	**3**	**1.5**

Course Objectives	To Impart knowledge in sampling and analysis of procedures of water and waste water samples to identify the water and waste water characteristics.

LIST OF EXPERIMENTS

1. Sampling and preservation methods for water and wastewater (Demonstration only).
2. Determination of pH & Electrical Conductivity.
3. Determination of Turbidity.
4. Determination of Chlorides.
5. a) Determination of Total Hardness.
   b) Determination of Calcium Hardness.
6. a) Determination of Alkalinity.
   b) Determination of Acidity.
7. Determination of Sulphates.
8. Determination of Iron & Fluoride.
9. Estimation of Residual Chlorine.
10. Estimation of Solids.
    a) Determination of Total Suspended solids.
    b) Determination of Dissolved solids.
    c) Determination of Fixed and Volatile solids.
    d) Determination of Total solids.
11. Determination of Optimum Coagulant Dosage.
12. Determination of Dissolved Oxygen.
13. Determination of BOD.
14. Determination of COD.
15. Demonstrations of water quality parameters for construction purpose.

Contact Periods: **Lecture: 0 Periods** **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret thesamplingandpreservation methodsofwaterandwastewater	K2
CO2	Correlate the physical properties of water and waste water.	K3
CO3	Correlate the chemical properties of water and waste water.	K3
CO4	Categorize thebiologicalproperties ofwaterand wastewater.	K3
CO5	Categorizethe Micro-biologicalproperties ofwaterandwastewater.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	0	1	1	2	1	2	0	0	0	2	0	0	0	1	0
CO2	2	2	1	2	0	2	1	0	0	0	0	0	0	1	0
CO3	2	1	1	2	0	2	2	0	0	0	0	0	0	1	0
CO4	2	1	1	2	0	2	2	0	0	0	0	0	0	1	0
CO5	1	1	1	2	0	2	1	0	0	0	0	0	0	1	0
22CPC 409	2	1	1	2	1	2	2	0	0	2	0	0	0	1	0

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.4, 3.1.5, 4.1.1,4.1.2, 4.3.1, 4.3.2, 4.3.4, 6.1.1, 10.1.1, 10.1.3
CO2	1.2.1,1.3.1,1.4.1,2.1.3,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.4,3.1.5,3.1.6,4.1.14.1.2,4.1.3,4.1.4,4.3.2,7.1.2
CO3	1.2.1,1.3.1,2.1.2,2.2.3,2.2.4,2.4.3,3.1.4,3.1.5,3.2.1,3.2.3, 4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.3.2,6.1.1,7.2.2
CO4	1.2.1,1.3.1,2.1.2,2.4.3,3.1.4,3.1.5,3.2.1,3.2.3,4.1.1,4.1.2,4.1.3,4.2.1,4.3.3,6.1.1,7.1.2,7.2.2
CO5	1.3.1,2.2.3,2.4.3,3.1.5,4.1.1,4.1.2,4.1.3,4.2.1,7.1.2

22CPC510	STRUCTURAL ANALYSIS I	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To demonstrate the fundamentals of analyzing various types of structures, cables, and suspension bridges; also, the influence line for beams, trusses, and arches will be explored.	
UNIT – I	**ENERGY METHODS**	**9 Periods**
Static and Kinematic Indeterminacy – Beams, Trusses and Frames –Equilibrium and Kinematic Stability — Energy principles – Strain energy and Complementary Energy – Principle of Virtual Work – Castigliano's First and Second Theorem –Theorem of least work – Clark Maxwell's reciprocal theorem – Application to simple problems of statically determinate beams, trusses and frames.		
UNIT – II	**ARCHES**	**9 Periods**
Three hinged arch – Two hinged arch – symmetrical and unsymmetrical - parabolic and circular arches under concentrated loads and uniformly distributed - Temperature effects – Rib shortening - Introduction to Fixed Arch.		
UNIT – III	**CABLES AND SUSPENSION BRIDGES**	**9 Periods**
Suspension bridges - Components and their Functions – Equilibrium of a loaded chord- Types of cable supports – Analysis of forces on Piers -Three hinged and Two-hinged stiffening girders.		
UNIT – IV	**ROLLING LOADS FOR DETERMINATE BEAMS AND ARCHES**	**9 Periods**
Rolling loads - Single concentrated load– UDL longer than the span – UDLshorter than the span– Two concentrated loads – Series of concentrated loads – Equivalent UDL. Influence lines for all types of loads (Determinate beams only). Influence lines for Symmetrical and Unsymmetrical arches – single rolling point load and uniformly distributed load.		
UNIT – V	**INFLUENCE LINES ON TRUSSES AND INDETERMINATE BEAMS**	**9 Periods**
Muller Breslau's principle - Influence lines for continuous beams - Influence lines for Trusses - Influence lines for Suspension bridges. Influence lines for Shear Force and Bending Moment.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Dr.R. Vaidyanathan, Dr.P. Perumal.,* ***"Structural Analysis I"****, Laxmi Publications, 2019.*
2	*Reddy C.S.,* ***"Basic Structural Analysis"****, Tata McGraw Hill Publishing Co., 2015.*

REFERENCES:

1	*R C Hibbler,* ***"Structural Analysis"*** *Pearson education,2017.*
2	*Dr.R. Vaidyanathan, Dr.P. Perumal.,* ***"Structural Analysis II"****, Laxmi Publications, 2017.*
3	*Thandavamoorthy.T. S.,* ***"Structural Analysis"****, Oxford Publishers, 2011.*
4	*Ramamurtham. S,* ***"Theory of structures"****, Dhanpat Rai & Sons, New Delhi, 2018.*
5	*Punmia B.C, Er. Ashok K Jain, Dr. Arun K Jain,* ***"Theory of Structures, SMTS.II"****, Laxmi publications, 2017*
6	*NPTEL notes -* **https://nptel.ac.in/courses/105105166**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze and predict the behavior of beams, Trusses, and Frames with various loads by energy principles	K3
CO2	Evaluate the internal forces and examine various arch forms under varied loads.	K3
CO3	Examine and ensure structural integrity, and performance of suspension bridges & cables, under diverse loads.	K2
CO4	Resolve the determinate beams and Arches with rolling loads	K2
CO5	Analyze indeterminate beams and trusses using ILD.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	1	-	-	1	2	-
CO2	3	3	1	2	2	-	-	-	-	1	-	-	1	-	-
CO3	3	3	1	2	2	-	-	-	-	1	-	-	1	-	-
CO4	3	3	1	2	2	-	-	-	-	1	-	-	-	-	-
CO5	3	3	1	2	2	-	-	-	-	1	-	-	1	2	-
22CPC510	3	3	1	3	2	-	-	-	-	1	-	-	1	2	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.2.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.3.1,10.3.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.1,3.1.2,3.2.1,4.1.2,4.1.3,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,10.3.1
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.1,3.1.2,3.2.1,4.1.2,4.1.3,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,10.3.1
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.1.2,3.2.1,4.1.2,4.1.3,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,10.3.1
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,3.1.2,3.2.1,4.1.2,4.1.3,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.3.1,10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPC511	DESIGN OF STEEL STRUCTURES	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To design the steel connection, tension member, compression steel member flexural members and the components of industrial buildings	
UNIT – I	**INTRODUCTION AND DESIGN OF STEEL CONNECTIONS**	**9 Periods**
Properties of Steel – Structural Steel Sections – Limit State Design Concepts – Loads on Structures – Bolted and Welded Connection – Design– Simple and Eccentric Connections.		
UNIT – II	**DESIGN OF TENSION MEMBERS**	**9 Periods**
Types of Sections – Net Area in Tension – Design of Tension Members –Lug Angles – Tension Splice – Concept of Shear Lag		
UNIT – III	**DESIGN OF COMPRESSION MEMBERS**	**9 Periods**
Axially Loaded Columns – Effective Length of Compression Members –Slenderness Ratio –Strength of Compression Members – Design of Columns – Built up Columns – Design of Lacing and Battens – Design of Slab Base – Gusseted Base.		
UNIT – IV	**DESIGN OF FLOORING SYSTEM AND FLEXURAL MEMBERS**	**9 Periods**
Concept of Floor System with Beams - Design of Laterally Supported and Unsupported Beams - Design of Built-up Beams - Design of Plate Girders.		
UNIT – V	**ROOFING SYSTEM AND INDUSTRIAL BUILDINGS**	**9 Periods**
Computation of Design Forces on Flat and Sloped Roof as per IS 875 - Design of Roof Members and Purlin using Angle and Channel Sections –Design Principle of Gantry Girder - Introduction to Pre-engineered Buildings		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Subramanian.N, "**Design of Steel Structures**", Oxford University Press, New Delhi, 2016.*
2	*Duggal.S.K, "**Limit State Design of Steel Structures**", McGraw Hill Education India (P) Ltd , New Delhi, 2014.*

REFERENCES:

1	*Bhavikatti S.S, "**Design of Steel Structures"**, Ik International Publishing House, New Delhi, 2017.*
2	*Gambhir M L, "**Fundamentals of Structural Steel Design"**, McGraw Hill Education India Pvt Limited, 2013*
3	*B.C.Punmia, Ashok Kumar Jain and Arun kumar Jain, **"Design of Steel Structures, Vol. I & II"**, Laxmi Publications (P) Ltd, 2014.*
4	*Ramachandra, "**Design of Steel Structures", Vol. I & II**, Standard publishers Distributors, New Delhi, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the different failure modes of bolted and welded connections, and design the connection.	K3
CO2	Design the most suitable sections for tension members.	K3
CO3	Apply the principles, procedures and current code requirements to the analysis and design of steel columns and column bases.	K3
CO4	Design the laterally restrained and unrestrained steel beams.	K3
CO5	Design the structural components of industrial buildings.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	2	-	-	-	1	-	-	-	-	-
CO2	2	2	1	1	-	2	-	-	1	1	-	-	2	2	1
CO3	2	2	1	1	-	2	-	-	1	1	-	-	2	2	1
CO4	2	2	1	1	-	2	-	-	1	1	-	-	2	2	1
CO5	2	2	1	1	-	2	-	-	1	1	-	-	2	2	1
22CPC511	2	2	1	1	-	2	-	-	1	1	-	-	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2, 6.2.1, 10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPC512	WASTEWATER ENGINEERING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To study about sewage composition, their characteristics, sewer design and sewage treatment processes along with their disposal methods.	
UNIT – I	**QUANTITY AND HOUSE DRAINAGE**	**9 Periods**
Necessity and objectives of sanitary engineering projects-Definitions-systems of sewerage -quantity of sewage - Fluctuations in flow pattern - Estimation of storm runoff - DWF and WWF-Design flow for separate and combined systems – General layout of house drainage - Principles of house drainage, pipes and traps- one pipe system, two pipe system.		
UNIT – II	**SEWER AND SEWER APPURTENANCES**	**9 Periods**
Hydraulics of sewers - Self cleansing velocities – Design of sewer – principle and procedure full flow / partial flow conditions - sewer sections - materials for sewers - sewer joints – laying of sewerage system – sewer cleaning and maintenance- sewage pumping-types of pumps – underground drainage system.		
UNIT – III	**QUALITY OF SEWAGE AND PRIMARY TREATMENT**	**9 Periods**
Characteristics and composition of sewage - physical and chemical analysis - DO, BOD, COD and their ssignificance - cycles of decomposition - Objectives and basic principles of sewage treatment -primary treatment- screens - Grit chamber - principles of sedimentation - Design of settling tanks.		
UNIT – IV	**BIOLOGICAL TREATMENT OF SEWAGE**	**9 Periods**
Basic principles of biological treatment - Filtration - contact beds - Sand Filters – trickling filters - Description and principles of operation of standards / high-rate filters - diffuser /Mechanical aeration - Conventional, high rate and extended aeration process - recirculation - activated sludge process – oxidation pond– Membrane Bioreactor – UASB, stabilization ponds-aerated lagoons- Septic tanks and effluent disposal system- Recent Advances in Sewage Treatment.		
UNIT – V	**SEWAGE DISPOSAL AND SLUDGE MANAGEMENT**	**9 Periods**
Objectives of sludge treatment- properties and characteristics of sludge-Thickening- bio digester - sludge digestion - drying beds - conditioning and dewatering - sludge disposal - Eutrophication - recycle & reuse of waste effluents -self-purification of streams –oxygen sag curve-land disposal – sewage farming.		
Contact Periods **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*Garg S.K., **"Sewage Disposal and Air Pollution Engineering"**, Khanna Publishers, New Delhi,2021*
2	*S. C. RangwalaandK. S. Rangwala, **"Water Supply and Sanitary Engineering"**, CharotarPublishinghouse2022*

REFERENCES:

1	*Punmia B.C, Jain A.K and Jain A.K, **"Environmental Engineering, Vol-II"** LaxmiPublications,2016*
2	*Hussain.S.K., **"TextBookofWaterSupplyandSanitaryEngineering"**, OxfordandIBHPublishing, 2017*
3	*MetcalfandEddy**"WasteWaterEngineering-TreatmentandReuse"**TataMcGrawHillCompany, NewDelhi 2017*
4	*Duggal.K.N., **"ElementsofpublicHealthEngineering"**,S.ChandandCo,2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Attain knowledge on sewage production and house drainage.	K2
CO2	Design of sewerage system.	K3
CO3	Analyse the quality of sewage and design of primary treatments of sewage.	K2
CO4	Plan and design the biological treatments of sewage.	K2
CO5	Apply suitable sludge treatment and disposal method.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	0	3	1	-	-	1	-	-	1	1	1
CO2	2	1	3	1	0	3	2	-	-	1	-	-	1	1	1
CO3	2	1	2	2	1	3	2	-	-	1	-	-	2	2	1
CO4	2	1	2	1	1	3	2	-	-	1	-	-	2	2	1
CO5	2	1	2	2	1	3	2	-	-	2	-	-	2	2	1
22CPC512	2	1	2	2	1	3	2	-	-	2	-	-	2	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1,1.4.1,2.4.3,3.1.4,3.1.5,3.2.1,3.2.3,3.3.1,4.1.1,4.1.2,6.1.1,6.2.1,7.2.2,10.1.1,10.2.2
CO2	1.2.1,1.3.1,1.4.1,2.1.3,2.2.3,2.3.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1,4.1.2,4.2.2,6.1.1,6.2.1,7.1.2,7.2.2,10.1.1,10.3.1
CO3	1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,3.1.5,3.2.1,3.2.2,3.2.3,3.4.2,4.1.1,4.1.2,4.2.1,4.2.2,4.3.1,5.1.1,6.1.1,6.2.1,7.1.2,7.2.2,10.1.1,10.3.1
CO4	1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,3.1.5,3.2.1,3.2.2,3.2.3,3.4.2,4.1.1,4.1.2,4.2.2,5.1.1,6.1.1,6.2.1,7.1.2,7.2.2,10.1.1,10.3.1
CO5	1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,3.1.5,3.2.1,3.2.2,3.2.3,3.4.2,4.1.1,4.1.2,4.2.1,4.2.2,5.1.1,6.1.1,6.2.1,7.1.2,7.2.2,10.1.1,10.2.2,10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPC513	HIGHWAY AND RAILWAY ENGINEERING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To give an overview about the highway and railway engineering with respect to, planning, design, construction and maintenance as per IRC standards, specifications and methods.	
UNIT – I	**HIGHWAY DEVELOPMENT, PLANNING AND GEOMETRICS**	**9 Periods**
Highway development and planning, Classification of Highways, Highway alignment. Highway Geometric Design– Typical cross sections -Cross sectional elements-Sight distance- Horizontal alignments-Vertical alignments.		
UNIT – II	**DESIGN, CONSTRUCTION AND MAINTENANCE OF PAVEMENTS**	**9 Periods**
Pavements – types –Components-functions- Design factors- Design of flexible pavements- Design of rigid pavements- Design of joints-IRC recommendations only. Construction of roads – W.B.M. roads –Bitumen roads –Cement concrete roads. Application of geotextile in the construction of road. Failure of pavements. Maintenance of highway – Evaluation -Strengthening of pavements-Types of overlays.		
UNIT – III	**TRAFFIC STUDIES AND CONTROL**	**9 Periods**
Traffic Characteristics. Traffic studies - traffic volume studies - Speed studies - origin and destination study - traffic flow characteristics - traffic capacity study - parking study - Accidental studies. Traffic operations - taffic regulations - traffic control devices - road markings. Design of road intersections. Design of parking facilities. Highway lightings.		
UNIT – IV	**RAILWAY MATERIALS, PLANNING AND DESIGN**	**9 Periods**
Location surveys and alignment - Conventional and Modern methods. Permanent way - Gauges - Components - Functions and requirements - Coning of Wheels. Geometric design- Gradients-Grade Compensation - Super-Elevation- Transition Curves- Widening of Gauges.		
UNIT – V	**RAILWAY TRACK OPERATION AND MAINTENANCE**	**9 Periods**
Points and Crossings - Turnouts – Types - Working Principle. Signaling, Interlocking and Track Circuiting. Construction and Maintenance – Conventional and Modern methods. Railway Stations and Yards. Modern developments in railways, urban railways–Basic planning for LRT & MRTS – Feasibility Study.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, "**Highway Engineering**", Nemchand and Bros,Tenth Edition,2013*
2	*Saxena S.C and Arora S.P., **"Railway Engineering"**, DhanapatRai Publications, 6th Edition,2010*

REFERENCES:

1	*Satishchandra & MM Agarwal., "**Railway Engineering**", Oxford University Press, Second Edition, 2013.*
2	*Sharma S.K, **"Principles, Practice& Design of Highway Engineering"**, S.Chand and Co,2014.*
3	*Rangwala S.C & K.S. **"Railway Engineering"**, Charotar Publications, 14th Edition, 2008*
4	*K.P.Subramanian, **"Transportation Engineering: Highway Railway Airport & Harbour Engineering"**, Scitech publications (India) Pvt. Ltd, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Illustrate the development, planning and geometric design standards for highways.	K3
CO2	Design, construct and maintenance of flexible and rigid pavements.	K3
CO3	Apply the knowledge of the traffic studies and implement traffic regulation and control measures and intersection design	K3
CO4	Outline the planning of railways and perform geometric design	K3
CO5	Summarize the process of operation, maintenance of railway track and modern development in railway.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	1	3	3	2	-	-	-	1	2	2	2	2	2
CO2	2	3	1	3	3	2	-	-	-	1	-	2	2	2	2
CO3	2	3	1	3	3	2	-	-	-	1	-	2	2	2	2
CO4	2	3	1	3	3	2	-	-	-	1	2	2	2	2	2
CO5	2	3	1	3	3	2	-	-	-	1	2	2	2	2	2
22CPC513	2	3	1	3	3	2	-	-	-	1	2	2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.1, 10.1.1, 10.1.2, 11.1.1, 11.2.1, 12.2.1, 12.2.2, 12.3.1
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.1, 10.1.1, 10.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.1, 10.1.1, 10.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.1, 10.1.1, 10.1.2, 11.1.1, 11.2.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.4, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1,4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.2.1, 10.1.1, 10.1.2, 11.1.1, 11.2.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPC514	MECHANICS OF SOILS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objective	To understand the types of soil, minerals and structure, the physical and engineering characteristics of soil, evaluate stresses in soils and to understand the flow through soil.	
UNIT – I	**BASIC PROPERTIES OF SOILS**	**9 Periods + 3 Periods**
Origin and classification of soils-Soil deposits of India- – Clay minerals and soil structure-Problematic soils-Physical properties of soil – Phase relations –Index properties- Soil classification system –significance.		
UNIT – II	**STRESSES IN SOILS**	**9 Periods + 3 Periods**
Soil water statics –effective and neutral stresses –effect of water table- Capillary phenomenon – stresses in soil from external loads – Boussinesq's theory– Newmark's chart Approximate methods – Pressure bulb – Westergaard's equation.		
UNIT – III	**PERMEABILITY AND SEEPAGE**	**9 Periods + 3 Periods**
One dimensional flow through soil – Permeability – Darcy's law – Laboratory and field methods – Factors influencing permeability – Flow through stratified soil – Seepage Analysis-Introduction, stream function and potential function-Seepage pressure – Quick sand condition – Soil liquefaction – Two dimensional flow – Laplace equation – Electrical analogy – Flow net –Methods of construction – Properties – Applications – Sheet pile cut off –flow through dams and filters..		
UNIT – IV	**COMPACTION AND CONSOLIDATION**	**9 Periods + 3 Periods**
Compaction – Laboratory tests – Factors affecting compaction – Field compaction methods – Compaction control. Consolidation – types- Laboratory test – Interpretation of consolidation test results-Determination of Cv by curve fitting methods – Terzaghi's theory of consolidation – Cconsolidation settlement-Maximum past stress, OCR – Pre-consolidation pressure – pressure void ratio relationship– Time factor – Time rate of consolidation.		
UNIT – V	**SHEAR STRENGTH**	**9 Periods + 3 Periods**
Mohr's circle – Characteristics- Principal stresses- Mohr-Coulomb's strength criterion – Factors affecting shear strength – Types of shear tests– Direct shear – stress strain relationship- critical void ratio- Triaxial compression– Drainage conditions – UCC –-Vane shear – Skempton's pore pressure coefficients.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOKS:

1	*Gopal Ranjan and Rao, A.S.R.,**"Basic and Applied Soil Mechanics",** New Age International Publishers, Third Edition, New Delhi, 2019.*
2	*Palanikumar, M.,**"Soil Mechanics"**, PHI Learning Pvt. Ltd., 2013.*

REFERENCES:

1	*Murthy, V.N.S.,**"Geotechnical Engineering: Principles and Practices of Soil Mechanics and Foundation Engineering"**, CBS Publishers' 2018.*
2	*Braja M.Das and N.Sivakugan **"Introduction to Geotechnical Engineering",** Cengage Learning Second edition, 2015.*
3	*Muni Budhu ,**"Soil Mechanics and Foundations",** Wiley Publishers Third Edition, 2016.*
4	*Cudoto, D.P., Kitch W.A., and Yeung M.R., **"Geotechnical Engineering: Principles and Practices",** Pearson India Education Services, 2018.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify different types of soil including problematic soils, perform laboratory experiments to assess the physical, engineering properties of soil and to classify the soil.	K2
CO2	Plot stress distribution diagrams and compute vertical stress due to various loading conditions.	K2
CO3	Evaluate the permeability and seepage through soils.	K2
CO4	Examine compaction process and interpret consolidation characteristics of soils.	K2
CO5	Determine graphically and analytically the shear stresses in any plane	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	1	-	-	1	-	-	3	3	3
CO2	3	1	1	-	-	2	-	-	-	1	-	-	-	2	1
CO3	3	2	1	1	-	2	-	-	-	1	-	-	3	3	2
CO4	3	1	1	1	-	2	1	-	-	1	-	-	3	3	3
CO5	3	1	1	1	1	3	-	-	-	1	-	-	3	3	3
22CPC514	3	2	1	1	1	3	1	-	-	1	-	-	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 3.1.4, 4.3.1, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 10.1.1
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.1.4, 2.4.4, 6.2.1, 10.1.1, 10.3.1
CO3	1.1.1,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.3.1,2.3.2,2.4.1,2.4.2,3.1.4,4.3.1,6.2.1. 10.1.1
CO4	1.1.1, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.3.2, 3.1.4, 4.3.1,6.2.1,7.1.2, 10.1.1
CO5	1.1.1, 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.3.1, 3.1.4, 4.3.1, 5.3.1, 6.1.1, 6.2.1, 10.1.1, 10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	60	-	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	60	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22CPC515	GEOTECHNICAL ENGINEERING LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objective	To impart practical knowledge on testing of soil for various physical properties and evaluate the engineering properties of the soil and determine the swell-shrink behaviour of soils.

LAB EXPERIMENTS / PROGRAMS:

1. Moisture content determination
2. Specific gravity and relative density test for sand.
3. Sieve analysis for coarse grained soil.
4. Hydrometer analysis for fine grained soil.
5. Consistency limits.
6. Field density tests (Sand replacement method and core cutter method).
7. Permeability tests (Constant Head method and variable Head method).
8. Direct Shear test.
9. Unconfined compression test for Soil.
10. Vane Shear Test for Cohesive Soil.
11. Standard Proctor's Compaction Test.
12. Consolidation Test.
13. Differential free swell tests.
14. Swell Pressure Test.
15. Triaxial Compression Test (Demonstration only).
16. Standard Penetration Test (Demonstration only).
17. SCPT and DCPT (Demonstration only).
18. Test on Geosynthetics (Demonstration only).
    a) Tensile Strength
    b) Interfacial friction angle

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Determine index properties of soil and classify the soil based on the index properties of soil.	K2
CO2	Calculate the engineering properties of soil	K3
CO3	Evaluate the differential free swell index and swelling pressure of soil. Analyze the field density and permeability characteristics of soil.	K3
CO4	Analyze and interpret the experimental results for the suitability of soil for different types of foundations.	K3
CO5	Obtain the knowledge on handling of field testing equipments	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	2	-	-	1	1	-	-	1	1	1
CO2	3	3	2	2	1	2	-	-	1	1	-	-	1	2	2
CO3	3	2	2	2	1	2	-	-	1	1	-	-	1	2	2
CO4	3	3	1	2	1	2	-	-	1	1	-	-	1	2	2
CO5	2	2	1	1	1	2	-	-	1	1	-	-	1	2	2
22CPC515	3	3	2	2	1	2	-	-	1	1	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 4.1.1, 4.1.2,5.3.1, 6.2.1,9.3.1 10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.3.1,6.2.1, 9.3.1, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2,5.3.1, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.3.1,6.2.1, 9.3.1, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2,5.3.1, 6.2.1, 9.3.1, 10.1.1, 10.3.1

22CEE501	CONCRETE AND STRUCTURAL ANALYSIS LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	3	1.5

Course Objective	To learn the testing procedures for both fresh and hardened concrete and conduct experiments on various structural elements in accordance with IS codal provisions.

LIST OF EXPERIMENTS

PART A: Concrete Laboratory

1. Tests on Cement
2. Tests on Concrete - Fresh Concrete Properties
3. Tests on Concrete - Hardened Concrete Properties
4. Tests on Self Compacting Concrete
5. Non-Destructive Testing on Concrete (Demo only)

PART B: Structural Analysis Laboratory

1. Experiments on Trusses (Simple & Redundant)
2. Experiments on Arches, Suspension Bridge
3. Experiments on Beams (Simple, Unsymmetrical Bending & Torsion)
4. Experiments on Columns
5. Experiments on Portal Frames

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Investigate the properties of cement through experimentation.	K3
CO2	Assess the properties of fresh and hardened concrete systematically.	K3
CO3	Execute basic tests on Self-Compacting Concrete to evaluate its behavior.	K3
CO4	Analyze the structural behavior of Simple Steel Trusses and Arches through experimentation.	K3
CO5	Conduct experiments to examine the mechanical properties and structural performance of Beams and Frames.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	-	2	2	-	-	-	-	-	-	-	-	1	2	1
CO3	3	2	2	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	-	2	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	-	2	1	-	-	-	-	-	-	-	1	2	1
22CEE 501	3	2	2	2	1	-	-	-	-	-	-	-	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1,1.4.1, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3
CO2	1.3.1, 1.4.1, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3
CO3	1.3.1, 1.4.1, 2.1.3, 2.3.2, 2.4.3, 2.4.4, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.3.2
CO4	1.1.1, 1.3.1, 1.4.1, 2.1.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.3.1, 5.3.2
CO5	1.1.1, 1.3.1, 1.4.1, 2.1.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.3.1, 5.3.2

22CPC616	STRUCTURAL ANALYSIS II	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To learn slope deflection method, moment distribution method, matrix methods and plastic analysis in solving indeterminate structures.	
UNIT – I	**SLOPE DEFLECTION METHOD**	**9 Periods**
Analysis of continuous beams - Sinking of Supports - Analysis of single storey and single bay rectangular frames with and without sway.		
UNIT – II	**MOMENT DISTRIBUTION METHOD**	**9 Periods**
Distribution factor - Carry over factor - Analysis of continuous beams – Sinking of Supports - Analysis of single storey and single bay rectangular frames with and without sway.		
UNIT – III	**MATRIX FLEXIBILITY METHOD**	**9 Periods**
Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.		
UNIT – IV	**MATRIX STIFFNESS METHOD**	**9 Periods**
Analysis of continuous beams, indeterminate frames and trusses with maximum three degrees of kinematic indeterminacy – introduction to direct stiffness method (concepts only)		
UNIT – V	**PLASTIC ANALYSIS**	**9 Periods**
Plastic analysis: Beams in pure bending – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – Plastic analysis of indeterminate beams and frames – Upper and lower bound theorems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Punmia B.C, **"Strength of Materials and Mechanics of Structures, Vol.II."**, Standard Publishers, 2018*
2	*Vaidyanathan.R, Perumal.P., **"Structural Analysis II"**, Laxmi Publications, 2019.*

REFERENCES:

1	*Manickaselvam.V.K, **"Elementary Matrix Analysis of Structures"**, Khanna Publishers, New Delhi, 1998.*
2	*Bhavikatti.S.S, **"Structural Analysis"**, Vol.I and II, Vikas Publishing House Pvt. Ltd., 2021.*
3	*Negi, L.S. and Jangid, R.S, **"Structural Analysis"**, Tata McGraw-Hill Publications, 2008.*
4	*Reddy.C.S, **"Basic Structural Analysis"**, Third Edition, Tata McGraw-Hill Publications, 2017.*
5	*Pandit.G.S.andGuptaS.P., **"Theory of Structure, Vol.I"**, TataMcGraw–Hill,NewDelhi, 2017.*
6	*NPTEL notes - https://nptel.ac.in/courses/105105109.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyse beams and frames using slope deflection method.	K2
CO2	Analyse beams and frames using moment distribution method.	K2
CO3	Analyse beams, frames and trusses by flexibility method.	K2
CO4	Analyse beams, frames and trusses by Stiffness method.	K2
CO5	Do plastic analysis in beams and frames.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO 3**
CO1	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
CO4	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
CO5	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
22CPC616	3	2	1	2	-	-	-	-	-	-	-	-	1	3	3
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1,3.1.1,3.1.6,4.1.2, 4.1.4,4.3.3
CO2	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 3.1.1,3.1.6,4.1.2, 4.1.4,4.3.3
CO3	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 3.1.1,3.1.6,4.1.2, 4.1.4,4.3.3
CO4	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 3.1.1,3.1.6,4.1.2, 4.1.4,4.3.3
CO5	1.1.1, 1.1.2,1.3.1,1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 3.1.1,3.1.6,4.1.2, 4.1.4,4.3.3

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPC617	DESIGN OF CONCRETE STRUCTURES	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To get more familiar with the behaviour, design, and detailing of reinforced concrete footings, retaining walls, flat slabs, also to apply the ductile detailing and earthquake-resistant design of structures.	
UNIT – I	**FOOTINGS**	**9 Periods**
Design of Eccentrically loaded footings for columns – Combined rectangular footings – Combined trapezoidal footings for an axially loaded column - Strap beam footings – Detailing of Reinforcement - Design steps of raft foundations.		
UNIT – II	**EARTH RETAINING STRUCTURES**	**9 Periods**
Types of retaining walls – Applications- Structural behaviour of retaining walls- Stability requirements of retaining wall - Design of Cantilever retaining wall and Counterfort retaining wall – detailing of reinforcement.		
UNIT – III	**FLAT SLAB DESIGN**	**9 Periods**
Design loads other than earthquake loads (only an introduction) – Imposed loads, wind loads, construction loads – Types of flat slab – Equivalent frame method – Introduction to yield line theory.		
UNIT – IV	**LIQUID RETAINING STRUCTURES**	**9 Periods**
Water Tank - Resting on the ground- Underground Tank- Rectangular and Circular tanks as per IS code (Working Stress design method) – Design principles of overhead tanks including staging and foundation. Introduction to Limit State Design (Principles Only)		
UNIT – V	**EARTHQUAKE FORCES – DUCTILE DETAILING**	**9 Periods**
Earthquake forces – Bureau of Indian Standards for Earthquake resistant design – Earthquake magnitude and intensity – Basic seismic coefficients and seismic zone factors – Design forces – Design factors – Analysis of structures (Portal Method and Cantilever method)– Choice of method for multistoried buildings. Ductile detailingof frames for seismic forces – General principles.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXTBOOKS:

1	*Pillai and Menon, **“Reinforced Concrete Design”**, McGraw Hill Education (India) Private Ltd., 2021.*
2	*Pankaj Agarwal and Manish ShriKhande, **“Earthquake Resistant Design of Structures”**,Prentice-Hall of India, New Delhi, 2011.*

REFERENCES:

1	*Sinha.S.N., **“Reinforced Concrete Design”**, Tata McGraw Hill publishing company Ltd., 2017.*
2	*Ramachandra, **“Design of Concrete Structures – Vol 1”**, Standard Book House, Delhi, 2007.*
3	*V.L.Shah and S.R.Karve **“Limit state theory and design of reinforced concrete”**, Structure Publications, 2005.*
4	*Vazirani & Ratwani, **“Design of R.C.C Structures”**, Khanna Publishers, 2006.*
5	IS:456-2000 (R2016), "***Plain and Reinforced Concrete - Code of practice***".
6	SP:16-1980, “***Design Aids for Reinforced Concrete to IS 456:(1978)".***
7	IS:3370-2021***, "Code of practice Concrete Structures for Storage of Liquids".***
8	IS 13920(2016), *Indian Standard Code of practice for “**Ductile detailing of Reinforced concrete structures subjected to seismic forces”.***
9	BIS 1893-2016- ***Indian Standard Code of practice for Criteria for Earthquake resistant design of structures.***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the type of foundation and design as per BIS code.	K3
CO2	Select suitable retaining walls and design as per the BIS code.	K3
CO3	Design of Flat slabs as per BIS code.	K3
CO4	Design water tanks following BIS requirements.	K3
CO5	Apply the provisions of earthquake-resistant design and ductile detailing of structures	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	2	-	-	-	1	-	1	-	3	1
CO2	3	3	2	1	2	2	-	-	-	1	-	1	-	3	2
CO3	3	3	2	1	2	2	-	-	-	1	-	1	-	3	1
CO4	3	3	2	1	2	2	-	-	-	1	-	1	-	3	2
CO5	3	3	2	1	2	3	1	-	-	1	-	1	-	3	2
22CPC617	3	3	2	1	2	2	1	-	-	1	-	1	-	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.3.3,5.1.1,5.1.2,5.2.1,6.2.1,10.3.1,12.3.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.4.1,4.1.1,4.1.2,4.3.3,5.1.1,5.1.2,5.2.1,6.2.1,10.3.1,12.3.1
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.3,3.4.1,4.1.1,4.1.2,4.3.3,5.1.1,5.1.2,5.2.1,6.2.1,10.3.1,12.3.1
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.4.1,4.1.1,4.1.2,4.3.3,5.1.1,5.1.2,5.2.1,6.2.1,10.3.1,12.3.1
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.3.1,3.4.1,4.1.1,4.1.2,4.3.3,5.1.1,5.1.2,5.2.1,6.1.1,6.2.1,7.1.1,10.3.1,12.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPC618	WATER RESOURCES ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To provide knowledge on hydrological cycle, water resources and its transportation	
UNIT – I	**SURFACE WATER HYDROLOGY**	**9 Periods**
Hydrological Cycle – Precipitation – forms and types – Average rainfall over a basin – Arithmetic mean, Thiessen polygon and Isohyetal method – missing precipitation – optimum numbers. Abstractions from Precipitation – Runoff process – Estimation of Surface Runoff – Empirical formulae, Infiltration Indices and Unit Hydrograph method		
UNIT – II	**CROP WATER REQUIREMENT AND RESERVOIR PLANNING**	**9 Periods**
Crop water requirement – capacity of canals – types of reservoirs – Investigation for reservoir planning – Selection of site for a reservoir – Zones of storage in reservoirs –Yield of a reservoir – Safe, secondary and average yield – mass curve and demand curve – Calculation of safe yield from a reservoir of a given capacity – Determination of reservoir capacity for a specified yield		
UNIT – III	**GRAVITY DAM**	**9 Periods**
Forces acting and their computation – Modes of failures – Elementary profile of a gravity dam – Practical profile – High and Low gravity dams – Stresses acting on dam – Design procedure for a gravity dam – Problems to check stability Analysis		
UNIT – IV	**DISTRIBUTION SYSTEM**	**9 Periods**
Classification of Canals – canal alignment – Design procedure for an unlined irrigation channel - Kennedy's theory – Wood table – Lacey's theory – Comparisons of the two theories – Uses of Garret's diagram in channel design – Balancing depth of cutting – component parts of a canal cross section – design of lined canals – Problems.		
UNIT – V	**GROUND WATER HYDROLOGY**	**9 Periods**
Occurrence of ground water – types of aquifers – Storage coefficient – coefficient of transmissibility and permeability – types of open and tube wells. Steady radial flow into a well –Yield estimation of unconfined and confined aquifers – Yield from an open well by constant level pumping test and recuperation test – well loss – Site selection for a tube well – Problems.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Punmia.B.C. and Pande B.B. Lal, **"Irrigation and Water Power Engineering"**, Laxmi Publications Pvt. Ltd, New Delhi, 2021.*
2	*Santosh Kumar Garg, **"Irrigation Engineering and Hydraulics Structures"**, Khanna Publishers, New Delhi, 2023.*

REFERENCES:

1	*P.N.Modi, **"Irrigation water resources and Water Power engineering"**, Standard book House, New Delhi, 2020.*
2	*Duggal .K.N and Soni. J.P, **"Elements of Water Resources Engineering"**, New Age International Pvt. Ltd, New Delhi, 2011.*
3	*Gupta. B. L and Amit Gupta, **"Water resources System and Management"**, Standard Publishers Distributors, New Delhi, 2008.*
4	*Satya N Murthy, chella**, "Water Resources Engineering : Principles and Practice",** New age Publishers, 2020*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the hydrological cycle, equations and its components	K2
CO2	Fix the reservoir capacity and their yield predictions for a demand	K2
CO3	Check the forces acting and stability analysis of gravity dam.	K2
CO4	Design the section of lined and unlined canals	K3
CO5	Conduct the yield tests in open and tube wells in real fields.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	-	1	-	-	-	-	-	-	-	-	1	2	2
CO2	3	2	2	1	-	-	-	-	-	-	-	-	1	2	2
CO3	3	2	2	1	-	-	-	-	-	-	-	-	1	2	2
CO4	3	2	2	1	1	-	-	-	-	-	-	-	1	2	2
CO5	3	2	2	1	1	-	-	-	-	-	-	-	1	2	2
22CPC618	3	2	-	1	1	-	-	-	-	-	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 4.1.4
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 4.1.4, 5.3.1

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPC619	FOUNDATION ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	1	0	4

Course Objective	To acquire knowledge on different soil investigation methods, evaluate bearing capacity and settlement of foundations, understand design principles of machine foundation, calculate load carrying capacity of piles and to study earth pressure and slope stability analysis.	
UNIT – I	**SITE INVESTIGATION AND SELECTION OF FOUNDATION**	**9 Periods + 3 Periods**
Scope and objectives — Methods of exploration — Auguring and boring — Wash boring and rotary drilling —Geophysical methods- Depth and spacing of bore holes — Soil samples — Representative and undisturbed — Sampling methods — samplers-types— Penetration tests (SPT and CPT) — Data interpretation — Strength parameters — Bore log report and Selection of foundation.		
UNIT – II	**SHALLOW FOUNDATION**	**9 Periods + 3 Periods**
Location and depth of foundation — Codal provisions — Bearing capacity of shallow foundation on homogeneous deposits — Terzaghi`s method and BIS method — Factors affecting bearing capacity — Bearing capacity from in-situ tests - plate load test — Allowable bearing pressure — Determination of Settlement of foundations on granular and clay deposits — Total and differential settlement — Allowable settlements — Codal provision — Methods of minimizing total and differential settlements.		
UNIT – III	**FOOTINGS AND MACHINE FOUNDATIONS**	**9 Periods + 3 Periods**
Types of Isolated footing- Combined footing- Mat foundation -types- Contact pressure and settlement distribution —Rigid and Flexible foundation- Proportioning of foundations — Applications — Compensated foundation — Codal provision. **Machine foundations:** Types - Free and forced Vibrations - General criteria for design of machine foundation -Block foundation - foundations subjected to impact loads (Design Principles only)		
UNIT – IV	**PILE FOUNDATION**	**9 Periods + 3 Periods**
Types of piles -functions— Factors influencing selection of pile — Carrying capacity of single pile in granular and cohesive soil — Static formula — Dynamic formulae (Engineering news and Hiley's methods) — Capacity from penetration tests—Group capacity-Efficiency of pile groups- Feld's rule- Converse — Labarre formula-Negative skin friction —Settlement of pile groups — Interpretation of pile load test (routine test only)- Under reamed piles — Construction and Use.		
UNIT – V	**SLOPE STABILITY AND EARTH PRESSURE**	**9 Periods + 3 Periods**
Stability of slopes – Types - failure mechanisms – Analysis of finite and infinite slopes- Types of failure – Slip circle method – Friction circle method –Stability numbers and charts. Plastic equilibrium in soils — Active and passive states — Rankine`s theory — Cohesionless and cohesive soil — Coulomb`s wedge theory — Condition for critical failure plane — Earth pressure on retaining walls of simple configurations — Culmann`s Graphical method — Pressure on the wall due to line load — Stability analysis of retaining walls — Codal provisions.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

Field tests on penetration test.

One observation tour of a site investigation projects and each student should prepare a brief report on the basis of prescribed data format.

TEXT BOOKS:

1	*Varghese P.C., **"Foundation Engineering",** Prentice Hall of India Pvt. Ltd., New Delhi, 2006.*
2	*Venkatramiah.C., **"Geotechnical Engineering",** New Age International (P) Ltd. publishers, NewDelhi, 2006.*
3	*Narasimha Rao A.V and Venkatramaiah C., **"Geotechnical Engineering",** Universities Press (India) Limited, 2000.*

REFERENCES:

1	*Cuduto., D.P., Yeung, M.R and Kitch, W.A., **"Geotechnical Engineering Principles and Practices",** Pearson Education Inc., New Jerse, 2011.*
2	*Shashi K.Gulhati and Manoj Datta, **"Geotechnical Engineering",** Tata McGraw Hill Publishing Company Ltd., NewDelhi, 2017.*
3	*Das, B.M., **"Principles of Foundation Engineering",** Cengage Learning, NewDelhi 2011.*
4	*Holtz, R.D., Kovacs, W.D and Sheahan, T.C., **"An introduction to Geotechnical Engineering",** Second Edition, Pearson Publications, 2010.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify various methods of soil exploration, field testingand prepare soil investigation report.	K2
CO2	Estimate bearing capacity and settlement of foundations.	K2
CO3	Proportion shallow foundations and know the design principles of machine foundations.	K2
CO4	Select piles for different soil conditions and calculate the load carrying capacity.	K3
CO5	Analyse stability of slopes and calculate earth pressure on retaining walls.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**P O2**	**P O3**	**P O4**	**P O5**	**P O6**	**P O7**	**P O8**	**P O9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	1	1	2	1	3	1	-	-	3	3	-	3	3	3
CO2	3	2	1	2	1	2	1	-	-	1	2	-	3	2	2
CO3	3	1	2	1	-	2	-	-	-	1	-	-	2	2	1
CO4	3	2	2	2	1	2	1	-	-	1	2	-	3	3	3
CO5	3	2	2	1	1	3	2	-	-	1	-	-	2	2	2
22CPC 619	3	2	2	2	1	3	2	-	-	3	3	-	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.4.4, 3.1.1,3.1.4, 3.1.6,3.4.2,4.1.1, 4.1.2, 4.1.3, 4.1.6, 4.3.1, 4.3.2, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 10.1.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1
CO2	1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2. 1.3, 2.2.3, 2.4.4, 3.1.1,3.1.4, 3.1.6, 4.1.2, 4.1.4, 4.3.2, 4.3.4, 5.3.1, 6.2.1, 7.1.1, 10.1.1,10.3.1, 11. 2.1, 11.3.1
CO3	1.1.1, 1.2.1, 1.3.1, 1.4.1,2.1.1, 2.1.2, 2.1.3, 2.4.1, 2.4.4, 3.1.1, 3.1.4, 3.1.6, 3.2.2, 3.3.2, 4.1.4, 4.2.1, 4.3.1, 6.2.1, 10.1.1
CO4	1.1.1,1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2. 1.3, 2.2.1, 2.2.4, 2.4.4, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 3.4.2, 4.1.1, 4.1.2, 4.1.4, 4.3.2, 5.3.1, 6.2.1, 7.1.1,10.1.1,10.3.1,11. 1.2, 11.2.1, 11.3.1
CO5	1.1.1,1.2.1, 1.3.1, 1.4.1,2.1.1, 2.1.2, 2.1.3, 2.2.1,2.2.3, 2.3.2, 2.4.4, 3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.2, 3.4.2, 4.1.2, 4.1.4, 5.1.1, 5.3.1, 6.1.1, 5.2.1, 7.1.1, 7.2.2, 10.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40				100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	5	15	30	15	15	20	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	5	15	30	15	15	20	100
ESE	20	40	40	-	-	-	100

22CPC620	TRANSPORTATION ENGINEERING LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

Course Objective: To familiarise with the testing procedures of aggregates and bitumen, practical knowledge on traffic related studies and conduct traffic surveys.

LIST OF EXPERIMENTS

TESTS ON AGGREGATES

1. Aggregate Impact value test
2. Aggregate Crushing value test
3. Ten percent fines test
4. Flakiness and Elongation Index Test
5. Attrition and Abrasion test
6. Specific gravity and Aggregate Gradation Test
7. California Bearing ratio test

TESTS ON BITUMINOUS MATERIALS

1. Penetration test on Bitumen
2. Viscosity test on Bitumen
3. Ductility test on Bitumen
4. Softening Point test on Bitumen
5. Binder content of Bitumen
6. Flash and Fire Point (Demonstration)
7. Marshal Method of Mix Design (Demonstration)

TRAFFIC STUDIES

1. Roadway capacity study
2. Spot speed study
3. Traffic volume study

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Test the road aggregate for pavement construction.	K2
CO2	Determine the strength of subgrade soil.	K2
CO3	Conduct quality control tests on Bitumen.	K2
CO4	Carry out Bitumen mix design.	K3
CO5	Conduct Traffic surveys	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	3	-	-	-	-	-	-	1	2	-	-
CO2	3	3	1	3	3	-	-	-	-	-	-	1	1	-	-
CO3	3	3	1	3	3	-	-	-	-	-	-	1	1	-	-
CO4	3	3	1	3	3	-	-	-	-	-	-	1	1	-	-
CO5	3	3	1	3	3	-	-	-	-	-	-	1	1	-	-
22CPC620	3	3	1	3	3	-	-	-	-	-	-	1	1	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,3.1.4,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.2.1,12.2.2
CO2	1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,3.1.4,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.2.1,12.2.2
CO3	1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,3.1.4,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.2.1,12.2.2
CO4	1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,3.1.4,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.2.1,12.2.2
CO5	1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.4.1,2.4.2,2.4.3,3.1.4,3.1.6,4.1.1,4.1.2, 4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.2.1,12.2.2

22CEE602	COMPUTER AIDED CIVIL ENGINEERING DRAWING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	3	1.5

Course Objective	To learn about planning and preparation of building drawings as per Indian standards and familiarize National Building code, bye-laws for planning any building and drafting of detailed drawing of structural elements of any building in AutoCAD software with the regulations of Indian standards.

Principles of Residential and Public Buildings:
Concept of built environment and its application in planning. Recommendation of National building code. Green building, Introduction-National priorities, rating system, check list, Site selection and planning.

Principle of Planning for differently abled publics:
Standardization and Contextualization of accessibility in built environment, Overview of accessibility codes (National and International Perspectives).Accessibility Elements of Built Environment in urban and rural Contexts (Kerb Ramps, Bollards, Level and gratings, Ramps, Gradients and other relevant elements).Accessibility in public Sanitation System

Planning of Building:
Preparation of constructional details and drawings-plan, elevation, section, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window. Planning of building such as Residential building –Load bearing structure, RCC framed structure. Building for Education – school, college. Library Building for health –Dispensary, Hospital Industrial structure Building for entertainment-Theatre, club house, sports club. Other structure-Office, Hostel, Guest house

Building's Water Supply and Drainage & Solid Waste Collection and Disposal System: Design of water supply, waste water and storm water collection system for various types of buildings. Accessibility in public Sanitation Systems.

Electrical Services:
Domestic Supply, Distribution Circuits, basic wiring systems. Design and planning: - Lighting arrangements, Use of Solar Panels as source of power, Lightening Conductor for High-rise Buildings.

Building Planning and Computer Aided Civil Engineering Drawings (Laboratory) Course Content:
1. Preparation of detailed constructional plan of a residential building.
2. Preparation of front elevation, detailed sectional view, site plan, foundation plan, terrace plan, waterproofing treatment, typical door and window.
3. Concept of perspective drawing- one point, two-point, three point and uses.
4. Preparation of line plans of various public buildings like: Building for Education – School, College. Library Building for health –Dispensary, Hospital Industrial structure Building for entertainment-Theatre, Club House, Sports Club. Other Structure- Office, Hostel, Guest house.
5. Prepare layout for water supply and drainage for a residential building and for multistoried buildings.
6. Building's Solid Waste Collection and disposal system: Wet and dry solid waste segregation, Vermi-composting.
7. Electrical wiring Layout and Fire Protection System which includes emergency exits and emergency vehicle routes with fire protection symbols

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

TEXT BOOKS:

1	*Kumara Swamy N. and Kameswara Rao A., **"Building Planning And Drawing"**, CharotarPublishingHousePvt.Ltd.,2013*
2	*Mark W.Huth Delmar, **"Understanding Construction Drawings"**,Cengage Publishers,2013.*

REFERENCES:

1	*Randy Shih, **“Autocad 2016 Tutorial First Level - 2D Fundamentals”**, Schroff Development Corp, 2015.*
2	*Donald Watson, **“Time-Saver Standards for Building Materials & Systems: Design Criteria and Selection Data"**, Tata Mc Graw Hill Education, 2009.*
3	***“National Building Code of India 2016”**, Volume 1 & 2,(ISBN: 8170610990) Reprint edition, Bureau of Indian Standards, Govt. of India,*
4	*Bureau of Indian Standards, " **Hand Book Of Functional Requirements Of Buildings, (SP-41 & SP- 32)"**, BIS 1987 and 1989, (SP-41: ISBN: 8170610117).*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Recognize the types of buildings, building regulations, paper sizes and tools for standard building drawing.	K2
CO2	Get knowledge about National Building Code, practice bye-laws and various IS codes relevant to construction drawings.	K2
CO3	Prepare the plan and elevation of buildings according to Indian standards.	K2
CO4	Draw the plan, elevation and sectional views with the aid of software in accordance with functional requirements and buildings rules as per National Building Code.	K3
CO5	Communicate effectively the design data and specifications through the detailed drawing of various structural elements and requirements through BIM.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	3	1	1	2	2	1	-	2	1	-	-	1	1	1
CO2	3	3	2	2	2	2	1	-	2	1	-	-	1	2	2
CO3	3	2	2	2	2	2	1	-	2	1	-	-	1	2	2
CO4	3	3	1	2	2	2	1	-	2	1	-	-	1	2	2
CO5	2	2	1	1	2	2	1	-	2	1	-	-	1	2	2
22CEE602	3	3	2	2	2	2	1	-	2	1	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2,5.1.1,5.3.1,5.3.2, 6.2.1,7.2.2,9.1.1,9.1.2,9.2.2,9.2.3 10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.1.1,5.3.1,5.3.2 6.2.1,7.2.2, 9.1.1,9.1.2,9.2.2,9.2.3, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.1.1,5.3.1,5.3.2 6.2.1,7.2.2, 9.1.1,9.1.2,9.2.2,9.2.3, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.1.1,5.3.1,5.3.2 6.2.1,7.2.2, 9.1.1,9.1.2,9.2.2,9.2.3, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.1.1,5.3.1,5.3.2 6.2.1,7.2.2, 9.1.1,9.1.2,9.2.2,9.2.3, 10.1.1, 10.3.1

22CES613	DESIGN THINKING FOR CIVIL ENGINEERING	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objective	Impart design skills to analyze design thinking issues and apply the tools and techniques of design.

DESIGN THINKING PROCESS AND PRACTICE

Design thinking: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test.

Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving.

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design.

EXERCISES

1. Preparation of 3D Model Layout /Architecture Planning Layout using Sketch Up/3D Max
2. Preparation of Interior Design Layout
3. Preparation of HVAC Design Layout
4. Visit to construction site. Observation of site conditions, structural, architectural and safety provisions
5. Preparation of layout for internal water supply, drainage pipes and fittings for public building
6. Identification of the Real-world Problem and Solution
7. Fabrication of Structural Elements/3D Printing
8. IoT Applications in Civil Engineering
9. Building Information Modeling-Structural and Architectural Model
10. Selection of Suitable Structures based on Demand and Site Conditions
11. Product Development

Contact Periods:
Lecture: 0 Period **Tutorial: 0 Periods** **Practical: 45 Periods** **Total: 45 Periods**

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Prepare model/layout drawings using suitable software tools.	K2
CO2	Illustrate benefits and barriers associated with multidisciplinary team works.	K2
CO3	Apply the Civil Engineering knowledge to identify the issues in construction field.	K3
CO4	Evaluate the suitable approaches to obtain a required final result.	K3
CO5	Predict the outcome of suggested approach in the form of product.	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	-	-	-	1	-	1	2	1	2
CO2	3	2	2	2	1	2	-	-	2	1	-	1	1	1	3
CO3	3	2	2	2	1	2	-	1	1	-	-	1	1	1	3
CO4	3	2	2	2	2	2	-	1	1	1	-	1	1	1	3
CO5	3	2	2	2	1	-	1	-	1	-	2	1	1	1	2
22CES613	3	2	2	2	1	2	1	1	1	1	2	1	1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 2.3.1, 3.1.4, 3.2.3, 3.3.1, 4.1.3, 4.3.3, 5.1.1, 10.1.1, 10.3.1, 12.3.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.4.1, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 4.1.1, 4.1.2,4.1.3, 4.3.2, 4.3.3, 5.1.2, 6.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 10.2.1, 12.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.4.1, 3.1.1, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 5.1.2, 5.3.1, 6.2.1, 8.2.2, 9.2.1, 12.1.2, 12.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.1, 2.4.3, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.4.1, 4.1.2, 4.1.4, 4.3.2, 4.3.3, 5.1.2, 5.3.1, 5.3.2, 6.1.1, 8.2.2, 9.3.1, 10.1.3, 10.3.1, 12.1.2, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.1, 4.1.2, 4.1.4, 4.2.1, 4.3.3, 5.2.1, 5.3.1, 7.1.1, 9.3.1, 11.1.1, 11.3.1, 12.3.2

ASSESSMENT PATTERN – PRACTICAL

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	40	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	40	10	-	-	100
ESE	20	30	40	10	-	-	100

22CHS706	CONSTRUCTION ENGINEERING AND MANAGEMENT	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objective	To plan, schedule, execution of construction projects using the basic concepts of management with the available materials, manpower, equipment and cost by software applications.	
UNIT – I	**PROJECT MANAGEMENT CONCEPTS AND PLANNING**	**9 Periods**
Basics of Construction – Unique features of construction – Principles of Management – Role of project manager – Types, features and phases of construction projects – Stakeholders – Functions of Management – Types of organization – Types of Business Operations – Sole proprietorship, Partnership, Joint ventures – Construction Planning – Pre-tender planning, Pre-construction planning and detailed construction planning – Modern Project Management systems such as Lean Construction.		
UNIT – II	**CONSTRUCTION SCHEDULING**	**9 Periods**
Work Breakdown Structure – Estimation of activity duration – Construction Scheduling – Scheduling techniques – Bar charts – Network techniques – Critical Path Method – PERT – Line of Balance method – Precedence Network Analysis – Crashing of Cost and Time – Resource Aggregation, Allocation, Smoothening and Levelling.		
UNIT – III	**MATERIALS AND EQUIPMENT MANAGEMENT**	**9 Periods**
Materials Management – Functions – Materials Planning – Procurement – Inventory Control – ABC Analysis, VED analysis, FSN analysis, SDE analysis and HML analysis – Economic Order Quantity. Construction Equipment – Earth-moving, Compacting, Concrete mixing, transporting and placing, Hauling and Hoisting Equipment – Dewatering Equipment – Equipment for Demolition – Use of Drones for spread out sites – Use of robots for repetitive activities.		
UNIT – IV	**HUMAN RESOURCE MANAGEMENT**	**9 Periods**
Importance, Functions and objectives – Manpower policy and planning – Recruitment and selection – Training Performance appraisal – Labour's Wage Policy and Compensation systems – Company union relationship and Collective bargaining – Safety, Health and Environment on project sites: Accidents, causes, effects and preventive measures – Absenteeism and Labour Turn over – Grievances/Conflicts – Identification and resolution.		
UNIT – V	**COST MANAGEMENT AND SOFTWARE APPLICATIONS**	**9 Periods**
Cost Management – Classification of construction cost – Cost coding – Cost Estimation – Project Budget – Cost control – Common causes of time and cost overruns and corrective measures – Funds: sources, S-Curves, cash flow. Software Applications: Project Management software – Introduction to MS Project and Primavera – Use of Building Information Modelling (BIM), Augmented Reality and Virtual Reality in Project Management.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*Chitkara, K.K., **"Construction Project Management Planning, Scheduling and Controlling"**, Tata McGraw-Hill Publishing Company Ltd., 2014.*
2	*Kumar Neeraj Jha, **"Construction Project Management: Theory and Practices"**, Pearson Publications, 2015.*

REFERENCES

1	*Joy P.K.,* ***"Total Project Management - The Indian Context, New Delhi",*** *Macmillan India Ltd., 2017.*
2	*Peurifoy R L,* ***"Construction Planning Equipment and Method"****, Tata McGraw Hill Publication, New Delhi, 2010.*
3	*Seetharaman S,* ***"Construction Engineering and Management",*** *Umesh Publications, 2017.*
4	*Sharma .S.C.,* ***"Construction Engineering and Management"****, Khanna Publishers, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Plan the construction projects with the available resources using the basic concepts of management.	K2
CO2	Schedule the construction projects using network techniques.	K2
CO3	Utilize the materials, equipment, manpower and cost effectively in construction industry.	K3
CO4	Maintain proper financial accounting systems in construction projects.	K3
CO5	Apply of project management software during execution of project.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	-	2	-	1	1	1	2	2	3	2	1
CO2	3	2	2	2	2	-	-	-	1	1	2	1	2	2	1
CO3	3	2	2	1	-	2	-	-	1	1	2	1	3	2	-
CO4	3	2	1	1	-	-	-	-	1	1	2	1	2	2	-
CO5	3	2	2	2	2	-	-	-	1	1	2	1	1	2	1
22CHS706	3	2	2	2	2	2	-	1	1	1	2	1	3	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.2, 2.2.4, 2.3.2, 2.4.4, 3.1.1, 3.1.5, 3.2.3, 3.3.1, 3.3.2, 4.1.1, 4.3.1, 4.3.2, 4.3.4, 6.1.1, 8.1.1, 9.1.2, 9.2.1, 10.1.2, 11.2.1, 11.3.1, 12.2.1, 12.2.2, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.3, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 3.2.3, 3.3.1, 3.4.1, 4.1.2, 4.1.4, 4.3.1, 4.3.3, 5.1.1, 5.2.2, 5.3.2, 9.3.1, 10.1.3, 11.3.1, 11.3.2, 12.2.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.4.2, 2.4.4, 3.1.2, 3.1.4, 3.1.6, 3.2.3, 3.3.1, 4.2.2, 4.3.3, 6.1.1, 8.1.1, 9.1.1, 9.1.2, 10.1.2, 11.1.1, 11.3.1, 12.3.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.2.2, 2.2.4, 2.3.2, 2.4.4, 3.1.2, 3.1.6, 3.2.3, 4.3.2, 4.3.3, 9.3.1, 10.3.1, 11.1.1, 11.1.2, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.4.3, 2.4.4, 3.1.1, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 4.1.2, 4.1.3, 4.1.4, 4.3.3, 5.1.1, 5.2.1, 5.3.2, 9.2.1, 9.3.1, 10.2.1, 11.2.1, 11.3.1, 12.3.2

ASSESSMENT PATTERN – PRACTICAL							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	30	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22CPC721	ESTIMATION, COSTING AND VALUATION	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To acquire knowledge to estimate the quantities of item of works in buildings, water supply, sanitary works, road works and to do rate analysis and valuation, prepare tender, contract documents and to write report.	
UNIT – I	**FUNDAMENTALS AND ESTIMATION OF BUILDINGS**	**9 Periods**
Fundamentals of Estimation – Different types of estimates – Methods of Estimation – Estimation of Buildings: Load bearing and framed structures with flat roof – Calculation of quantities of brick work, stone masonry, brick masonry, Plain Cement Concrete, Plastering, white washing, colour washing and painting – Estimation of doors and windows.		
UNIT – II	**ESTIMATION OF RCC WORKS AND OTHER STRUCTURES**	**9 Periods**
Bar bending schedules – Beam, Slab and Column, Foundation – Estimation of Septic Tank, Soak Pit, Retaining wall, Water Supply and Sanitary Installations – Bituminous Roads.		
UNIT – III	**RATE ANALYSIS**	**9 Periods**
Data – Types of Data – Scheduled of Rates – Lead statement – Analysis of Rates for Lime Mortar, Cement Mortar, Brick Masonry, Cement Concrete, Reinforced Cement Concrete, Damp Proof Course, Plastering, Painting and Flooring.		
UNIT – IV	**SPECIFICATION, TENDERS AND CONTR ACTS**	**9 Periods**
Specifications – Principles of specifications – Importance – Types of specifications – Specification for Excavation, Cement Concrete, Masonry Work. Tenders – E-Tendering – Contracts – Types of Contracts – Contract document.		
UNIT – V	**VALUATION AND REPORT WRITING**	**9 Periods**
Valuation – Necessity – Market Value – Book Value – Scrap Value – Salvage Value – Annuity – Capitalized Values – Sinking Fund –Depreciation – Escalation – Methods of Valuation – Valuation of a Building – Rent Fixation – Mortgage – Lease. Principles for report preparation – report on estimate of residential building.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 45 Periods**		

TEXT BOOK:

1	*Dutta, B.N.,* ***"Estimating and Costing in Civil Engineering"****, UBS Publishers and Distributors Private (Ltd) 2020.*
2	*Kohli D.D. and Kohli R.C.,* ***"A Text Book on Estimating, Costing (Civil)"****, S. Chand and Co, New Delhi, 2013.*

REFERENCES:

1	*Rangwala S.C.,* ***"Estimating and Costing",*** *Charotar Publishers & Co., New Delhi, 2017.*
2	*Chakraborthi M,* ***"Estimation, Costing and Specifications",*** *Laxmi Publications, 2006.*
3	*Banerjee D.N.,* ***"Principles and Practices of Valuation",*** *Eastern Law House, 2015.*
4	*Birdie G. S.,* ***"Estimating and Costing",*** *DhanpatRai Books Publishers, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Determine the quantity of various items of works.	K2
CO2	Prepare the detailed estimates of different structures.	K2
CO3	Evaluate the rate of various construction works.	K3
CO4	Indicate the specification of works and formulate tender and contract documents.	K3
CO5	Estimate the value of a property and prepare reports.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	3	2
CO3	3	2	1	1	-	-	-	-	-	-	1	-	1	3	2
CO4	3	1	1	1	-	-	-	-	1	-	1	1	-	3	1
CO5	3	1	1	1	-	-	-	-	-	1	-	1	-	3	2
22CPC721	3	2	1	1	1	-	-	-	1	1	1	1	1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 3.2.3
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.3, 3.2.3, 4.3.3
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 3.1.2, 3.2.3, 4.3.3, 11.1.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.4.4, 3.1.6, 4.3.3, 11.1.2, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.6, 4.3.3, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	30	-	-	-	100
CAT2	30	40	30	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	40	30	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

22CPC722	PRESTRESSED AND PRECAST CONCRETE STRUCTURES	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objective	To impart knowledge on the design concepts of prestressed and prefabricated elements, methods of construction and installation of precast elements.	
UNIT – I	**PRINCIPLES AND ANALYSIS OF PRESTRESS CONCRETE STRUCTURES**	**9 Periods**
Principles – Pretensioning – Posttensioning – Advantages and Types of prestressing – Systems of prestressing –Materials for prestressed concrete – calculation of fibre stresses for various section (Rectangle, I, T) of simply supported beam – Stress method – Moment of resistance method – Load balancing method. Various losses in prestressed concrete members – Deflection of prestressed concrete flexural members – calculation of long–term deflection.		
UNIT – II	**DESIGN OF FLEXURAL MEMBERS AND ENDBLOCK**	**9 Periods**
Pre tensioned and post tensioned simply supported rectangle, I, T sections – Calculation of ultimate flexural strength of section using IS code – Stress method – Design for flexure –Design for shear. End block – Analysis – Anchorage zone stresses–Guyon –Magnel's method – IS Code method – Design of End zone reinforcement.		
UNIT – III	**INTRODUCTION TO PREFABRICATION**	**9 Periods**
Prefabrication – Need of prefabrication – Comparison with monolithic construction –Advantages and Disadvantages – Methods of prefabrication – site and plant prefabrication – Types of precast systems –Modular coordination – Standardization– Tolerance. Precast concrete – Materials– Grouting.		
UNIT – IV	**PREFABRICATED COMPONENTS AND SYSTEMS**	**9 Periods**
Prefabricated elements –Beams–Columns– Roof units– Floor units– wall panels – footings. Structural System – Skeletal frame System – Large Panel System – Block System. Choice and planning of production setup – Manufacturing methods – Production process – Moulds – Acceleration of concrete hardening, Curing. Transportation and Erection of Elements.		
UNIT – V	**DESIGN PRINCIPLES**	**9 Periods**
Loads–Load combination, Disuniting of structures– Analysis of precast frames– Design of inverted Tee beam and L beam. Connection in precast building – Column to foundation connections, Wall panel to foundation connections, Beam to Column Connections, Column to column Connections, Floor to Beam Connections, Wall panel to Wall Panel Connection.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Krishnaraju.N, **"Prestressed concrete"**, 6th edition, Tata McGraw Hill Publishing company Ltd., New Delhi, 2018.*
2	*K.M. Elliott, **"Precast concrete structures"**, Butterworth Heinmann, 2002.*

REFERENCES:

1	*Muthu K. U., Ibrahim Azmi, JanardhanaMaganti, Vijayanand M, **"Prestressed Concrete"**, PHI Learning Pvt. Ltd., 2016.*
2	*Sinha. N.C and Roy.S.K, **"Fundamentals of prestressed concrete"**, S.Chand and Co. Ltd 2011.*
3	*NPTEL notes – https://nptel.ac.in/courses/105106117.*
4	*L. Mokk, **"Prefabricated Concrete for Industrial and Public Structures"**, Publishing House ofthe Hungarian Academy of Sciences, Budapest, 2007.*
5	*Structural Design Manual, **"Precast Concrete Connection Details"**, Society for the Studies inthe use of Precast Concrete, Netherland Betor Verlag, 2009.*
6	*Ganesan and Latha, **"Prefabricated structures"**, Sree Kamalamani Publications, Chennai,2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Describe the systems and evaluate the fibre stress, losses and deflection of prestressed elements.	K2
CO2	Design the prestressed concrete beam and end block.	K3
CO3	Select suitable materials and methods of prefabrication.	K3
CO4	Plan the structural system of prefabricated structures.	K2
CO5	Carryout the analysis and design of members and joints of precast building.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	-	-	-	-	-	-	1	2	2	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	2	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	1	2	2	-
22CPC722	3	3	1	-	-	-	-	-	-	-	-	1	2	2	-
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 4.1.1, 4.1.2, 12.1.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 4.1.1, 4.1.2, 12.1.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 4.1.1, 4.1.2, 12.1.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 4.1.1, 4.1.2, 12.1.1
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 4.1.1, 4.1.2, 12.1.1

ASSESSMENT PATTERN – PRACTICAL							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPC723	SOFTWARE APPLICATION LABORATORY	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	4	2

Course Objectives	To familiarize the programming skills for analysis, and design of various 2D and 3D Truss, Frames using the software, detailing as per code.

LIST OF EXPERIMENTS

DEVELOPMENT AND IMPLEMENTATION OF PROGRAM USING SOFTWARE

1. Design of singly and doubly reinforced beam
2. Design of Flanged beam
3. Design of one-way and two-way slab
4. Design of cantilever slab
5. Design of columns (axially load, Uni-axial and biaxial load)
6. Design of isolated and combined footings

DEVELOPMENT AND IMPLEMENTATION OF THE PROGRAM USING STAAD PRO. SOFTWARE

1. Analysis and Design of 2D Truss
2. Analysis and Design of 3D Truss
3. Analysis and Design of 2D Frame
4. Analysis and Design of a full PEB frame
5. Analysis and Design of RCC (G+1) building (Residential and Commercial)

Detailing of beams, slabs, columns, and foundations as per SP34 using AutoCAD.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Perform the design and detailing of structural elements using IS code.	K3
CO2	Analyze the structural systems under gravity and lateral loads.	K3
CO3	Analysis and design of steel and reinforced concrete structures as per IS Code.	K3
CO4	Compute the design loads on industrial structures.	K3
CO5	Interpret the behavior of structural systems and detailing using the software.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	-	-	-	1	-	-	2	-	-
CO2	3	3	2	2	3	3	-	-	-	1	-	-	1	-	-
CO3	3	3	2	3	3	3	1	-	-	1	-	-	1	-	-
CO4	3	3	2	2	3	2	-	-	-	1	-	-	1	-	-
CO5	3	3	3	3	3	3	1	-	-	1	-	-	1	-	-
22CPC723	3	3	2	3	3	3	1	-	-	1	-	-	1	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.4,2.3.1,2.4.1,2.4.3,2.4.4,3.1.1,3.1.3,3.1.4,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,10.3.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.1.4,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.4,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.16.2.1,10.3.1
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.1,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.1.4,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,10.3.1
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.3.1,2.3.2,2.4.3,2.4.4,3.1.1,3.1.3,3.1.4,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.2,4.3.4,5.1.1,5.1.2,5.2.2,5.3.1,5.3.2,6.2.1,10.3.1
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3,2.4.4,3.1.3.1.3,3.1.4,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,10.3.1

22CEE704	ANALYSIS AND DESIGN USING SOFTWARE LABORATORY	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	2	1

Course Objectives	To familiarize with the modern computing tools to formulate analyze and design of various concrete and steel structures using the software.

Development and Implementation of Structural Analysis and Design Using Software

1. Introduction to ETABS Interface and Toolbars
2. Creation of Structural Elements
3. Load Calculation and Application
4. Analysis and design of RC Beams and Columns
5. Analysis and design of a 3D RC Building.
6. Analysis and Design of Steel Truss Members
7. Analysis and Design of Pre-Engineered Building (PEB) Components

Contact Periods:
Lecture: 0 Periods **Tutorial: 0 Periods** **Practical: 30 Periods** **Total: 30 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and use the key features, interface components, and toolbars of ETABS for basic structural modelling tasks.	K3
CO2	Develop and set up structural models by defining elements and properties as per codal requirements	K3
CO3	Apply appropriate design loads, load cases, and load combinations as per Indian Standards.	K3
CO4	Analyse and design reinforced concrete structural components in compliance with IS codes.	K5
CO5	Analyse and design steel structural members in accordance with relevant codes.	K5

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping (Times New Roman, Size 11)

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**	**PSO 3**
CO1	2	1	0	0	2	-	-	-	-	-	-	-	-	2	1
CO2	3	2	2	0	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	2	0	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	2	3	-	-	-	-	-	-	-	-	3	3
22CEE704	3	3	3	2	3	-	-	-	-	-	-	-	-	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

22CEE705	ENGINEERING PROJECTS IN COMMUNITY SERVICE	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	4	2

Course Objectives	To provide an environment where teams of students can exercise their engineering skills by being exposed to realistic systems and customers and at the same time helping their community.
Problem identification – Identifying the issues within the community -Preliminary survey - Preparing a questionnaire, formats and survey forms. - A preliminary survey including the socio-economic conditions of the allotted habitation - Different types of surveys, tools and techniques for collecting the information. - Analysis of collected data and mapping of issues with the solutions available. - Based on the survey and the specific requirements of the habitation, Community Awareness Campaigns – Identifying the factors – Normalization of factors and finding the path way for problem solution – Selection of problem from the community and mapping of issues - Planning for working: Aim, objective and scope, time line - Application of engineering knowledge and tools for solutions Validation of the solution by supervising the execution of solution - Measuring the attainment of the solution: Feedback from community **Contact Periods**: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods**	

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify engineering related problems in the community.	K2
CO2	Analyze and Design different solutions to solve the problems of community.	K4
CO3	Apply economical solution to those problems in the field.	K4
CO4	To understand complexity and ambiguity	K1
CO5	Connections with professionals and community members for learning and career opportunities	K2

Course Articulation Matrix															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO2	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO3	-	2	2	-	1	2	1	-	2	-	1	-	1	1	1
CO4	-	2	2	-	1	2	1	-	2	2	1	-	1	1	1
CO5	-	2	2	-	1	2	1	-	2	2	1	-	1	1	1
22CEE705	-	2	2	-	1	2	1	-	2	1	1	-	1	1	1
1 – Slight, 2 – Moderate, 3 – Substantial															

22CEE807	CAPSTONE PROJECT	SEMESTER VIII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	16	8

Course Objective	To impart expertise in the broad field of Civil Engineering, either fully theoretical/Practical or involving both theoretical and practical work.

COURSE CONTENT:

It will be assigned by the Department for maximum of four students in a group, under the guidance of a Supervisor. During this period the students shall receive directions from the Supervisor for the progress of the Project Work. The students shall give periodical presentations of the progress made in the Project Work. Each student shall finally produce a comprehensive report in a prescribed format.

The Project Work shall be carried out in any of the Civil Engineering areas such as Construction Engineering, Structural Engineering, Environmental Engineering, Water Resources Engineering, Transportation Engineering, Geo-Technical Engineering and Remote Sensing.

The Project Work includes:

- Title, Scope of the project and Literature survey to be submitted within 2 weeks from the commencement of the project. In the first review by the constituted panel, the project may be accepted or rejected or major/minor changes can be suggested.
- Methodology, Requirement, Analysis and Deliverables to be submitted within 6 weeks from the commencement of the project.
- Project design and implementation plan have to be submitted within 8 weeks.
- Internal review will be conducted by the Mentor and this review has a weightage of 50%.
- Project (Software/Hardware) implementation to be done and demonstrate that the project meets the requirements and expectations.
- The results need to be analyzed and if any fine tuning required, it is to be done.
- Preparing a Dissertation in the standard format for being evaluated by the Supervisor
- Final evaluation: By expert committee at the end of the 10th week and this evaluation has a weightage of 50%.
- Final Seminar Presentation before a Committee.

Contact Periods:
Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify Specific Civil Engineering area and work for the real life needs.	K2
CO2	Choose the Standard Codes for specific Civil Engineering works.	K3
CO3	Apply latest techniques to analyze, modeling and simulation work.	K3
CO4	Find practical solutions to Civil Engineering Problems.	K4
CO5	Prepare the final detailed report.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	2	1	2	1	1	2	2	2	2	3	2	3
CO2	3	2	2	1	1	2	2	1	1	1	1	2	1	3	2
CO3	3	3	3	3	3	3	2	1	1	1	2	3	2	2	3
CO4	3	2	2	2	3	3	3	1	2	3	3	3	1	2	3
CO5	2	1	1	2	3	2	1	1	2	3	3	2	1	1	2
22CEE 807	3	2	2	2	3	3	2	1	2	3	3	3	1	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.3.2, 2.4.3, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 4.2.2, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 10.1.1, 10.1.2, 10.2.1, 11.1.1, 11.3.2, 12.1.2, 12.2.2, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.3.2, 2.4.2, 2.4.4, 3.1.1, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.3.1, 3.4.1, 4.1.2, 4.1.3, 4.2.2, 5.1.1, 5.1.2, 6.2.1, 7.1.2, 7.2.2, 8.2.1, 9.1.2, 9.2.2, 10.2.1, 11.2.1, 12.1.2, 12.2.1, 12.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.2, 2.2.4, 2.3.1, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.2, 8.2.2, 9.1.2, 9.2.2, 10.2.1, 11.1.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.4.2, 4.2.1, 4.3.1, 4.3.2, 4.3.3, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.1.1, 9.1.1, 9.2.2, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.3.1, 11.1.1, 11.2.1, 11.3.1, 11.3.2, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.3.1, 1.4.1, 2.2.2, 2.2.4, 2.4.2, 2.4.4, 3.1.2, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.1.4, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 6.2.1, 7.2.1, 8.2.2, 9.2.1, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 10.2.2, 10.3.1, 10.3.2, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.2.1, 12.3.1, 12.3.2

ASSESSMENT PATTERN – PRACTICAL							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	-	-	-	-	-	-
CAT2	-	-	-	-	-	-	-
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	30	40	10	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	30	40	-	-	100
ESE	20	20	30	40	-	-	100

22CPE$01	SMART MATERIALS AND SMART STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To gain the knowledge on strain measuring techniques, applications of smart materials and signal processing and control system.	
UNIT – I	**INTRODUCTION AND MEASURING TECHNIQUES**	**9 Periods**
Introduction to Smart Materials and Structures -Examples of intelligent materials, structural materials, Electrical materials. Strain Measuring Techniques using Electrical strain gauges, Types - Resistance – Capacitance – Inductance - Wheatstone bridges - Pressure transducers - Load cells - Temperature Compensation - Strain Rosettes.		
UNIT – II	**SENSORS**	**9 Periods**
Sensing Technology - Types of Sensors - Physical Measurement using Piezo Electric Strain measurement - Inductively Read Transducers - The LVDT - Fiber optic Techniques. Chemical and Bio - Chemical sensing in structural Assessment - Absorptive chemical sensors - Spectroscopes - Fibre Optic Chemical Sensing System and Distributed measurement.		
UNIT – III	**ACTUATORS**	**9 Periods**
Actuator Techniques - Actuator and actuator materials - Piezoelectric and Electrostrictive Material - Magneto structure Material - Shape Memory Alloys - Electro-rheological Fluids - Electromagnetic actuation - Role of actuators and Actuator Materials.		
UNIT – IV	**SIGNAL PROCESSING AND CONTROL SYSTEMS**	**9 Periods**
Data Acquisition and Processing - Signal Processing and Control for Smart Structures - Sensors as Geometrical Processors - Signal Processing - Control System - Linear and Non- Linear.		
UNIT – V	**APPLICATIONS IN CIVIL ENGINEERING**	**9 Periods**
Application of Shape Memory - Alloys in Bridges – Concept of Smart Bridges – Application of ER Fluids - Application of MR Dampers in Different Structures – Application of MR Dampers in Bridges and High Rise Structures – Structural Health Monitoring - Application of Optical Fibres - Concept of Smart Concrete.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Brain Culshaw, **"Smart Structure and Materials"** Artech House - Borton, London, 2003.*
2	*Srinivasan, A.V. and Michael McFarland, D. **"Smart Structures: Analysis and Design".** Cambridge University Press, 2010*

REFERENCES:

1	*L.S. Srinath, **"Experimental Stress Analysis"** Tata McGraw Hill, 2004.*
2	*Jayant Sirohi **"Smart Structure theory"** 2013*
3	*Adaptronics **"Smart materials & Structures"** Michael Sinapius, 2020*
4	*Zengtao **"Advanced Thermal stress Analysis of Smart materials and structures"** 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the various structural materials and measuring techniques in the field.	K3
CO2	Use the suitable sensors based on the field requirements.	K3
CO3	Employ appropriate actuator materials and actuators.	K3
CO4	Handle the signal processing and control system for smart structures.	K2
CO5	Apply structure-integrated sensing devices in Structural health monitoring (SHM) work.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	1	-	1	-	-	-	-	-	3	3	3
CO2	2	2	1	1	1	-	1	-	-	-	-	-	2	3	3
CO3	2	2	1	1	1	-	1	-	-	-	-	-	3	3	3
CO4	2	2	1	2	1	-	1	-	-	-	-	-	2	3	3
CO5	2	2	1	2	1	-	1	-	-	-	-	-	2	3	3
22CPE $01	2	2	1	2	1	-	1	-	-	-	-	-	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.2,2.4.4,3.1.5,4.1.1,4.1.2,4.2.1,5.1.1,7.2.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.2,2.4.4,3.1.5,4.2.1,5.1.1,7.2.1
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.2,2.4.4,3.1.5,4.2.1,5.1.1,7.2.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.2,2.4.4,3.1.5,4.1.1,4.1.2,4.2.1,5.1.1,7.2.1
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.2,2.4.4,3.1.5,4.1.1,4.1.2,4.2.1,5.1.1,7.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 /	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 /	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$02	EXPERIMENTAL STRESS ANALYSIS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To understand the different methods of experimental stress analysis and to gain knowledge on various strain gauges, non-destructive testing methods, distress measurement and the principles of photoelasticity.	
UNIT – I	**PRINCIPLES OF EXPERIMENTAL APPROACH**	**9 Periods**
Introduction - Merits of Experimental Stress Analysis - Applications of Experimental Stress Analysis - Different methods –Simplification of problems.		
UNIT – II	**STRAIN MEASUREMENT USING STRAIN GAUGES**	**9 Periods**
Definition of Strain - Properties of Strain Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical Strain Gauges -Inductance Strain gauges –LVDT –Resistance strain gauges –various types –Gauge factor.		
UNIT – III	**NON-DESTRUCTIVE TESTING METHODS**	**9 Periods**
Load Testing on Structures, Buildings, Bridges and Towers - Rebound Hammer- Acoustic Emission-Ultrasonic Testing, Principles and Applications - Holography - Use of Laser for Structural Testing.		
UNIT – IV	**DISTRESS MEASUREMENTS**	**9 Periods**
Diagnosis of Distress in Structures- Crack Observation and Measurement- Corrosion of Reinforcement in Concrete- Half Cell, Construction and Use- Damage Assessment - Controlled Blasting for Demolition.		
UNIT – V	**PHOTOELASTIC METHODS OF STRESS ANALYSIS**	**9 Periods**
Introduction – Stress-Optic Law – Effects of a Stressed Model in a Plane Polariscope– Effects of a Stressed Model in a Circular Polariscope– Tardy Compensation – Two-Dimensional Photoelastic Stress Analysis – Fringe Multiplication and Fringe Sharpening – Properties of Commonly Employed Photoelastic Materials – Material Calibration – Introduction to Three-Dimensional Photoelasticity and Digital Photoelasticity.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*J. W. Dally & W. F. Riley, **"Experimental Stress Analysis"** College House Enterprises, 2005.*
2	*U.C.Jindal, **"Experimental Stress analysis"**, Pearson Publications, 2012.*

REFERENCES:

1	*Sadhu Singh, **"Experimental Stress Analysis"**, Khanna publishers, New Delhi, 1996.*
2	*Dalley and Riley, **"Experimental Stress Analysis"**- McGraw Hill Book Company, New York 1991.*
3	*L.S.Srinath. **"Experimental Stress Analysis"**, Tata McGraw Hill company Book Ltd., NewDelhi. 1984*
4	*Bray and Stanley, **"Non-Destructive Evaluation"**, McGraw Hill Publishing co., New York,1989*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Demonstrate the principles of experimental approach.	K2
CO2	Use strain gauges for the measurement of strain.	K2
CO3	Perform Non-destructive testing methods on the existing structures.	K3
CO4	Diagnose the distressed structures using advanced damage assessing techniques.	K3
CO5	Apply the principles of photoelasticity in stress analysis techniques.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	3	3	-	-	-	-	1	3	-	-
CO2	3	1	1	1	-	3	3	-	-	-	-	1	3	-	-
CO3	3	1	1	1	-	3	3	-	-	-	-	1	3	-	-
CO4	3	1	1	1	-	3	3	-	-	-	-	1	3	-	-
CO5	3	1	1	1	-	3	3	-	-	-	-	1	3	-	-
22CPE$02	**3**	**1**	**1**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 3.1.5, 3.3.2, 4.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2,12.2.1,12.3.2
CO2	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 3.1.5, 3.3.2, 4.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2,12.2.1,12.3.2
CO3	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 3.1.5, 3.3.2, 4.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2,12.2.1,12.3.2
CO4	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 3.1.5, 3.3.2, 4.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2,12.2.1,12.3.2
CO5	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 3.1.5, 3.3.2, 4.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2,12.2.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$03	FINITE ELEMENT METHOD

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquaint the fundamentals of finite element theory, Comprehend different weighted residual, basic energy approaches, axisymmetric, isoparametric elements and real-world applications.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Concepts of Finite Element methods – Steps involved - Advantages & Disadvantages - Applications -Stresses and equilibrium - boundary conditions - Strain - displacement relations – Stress-Strain relationship - Potential energy and equilibrium - Weighted residual and weak formulations - Galerkin method - Variational approach - Rayleigh-Ritz method.		
UNIT – II	**FINITE ELEMENT FORMULATION**	**9 Periods**
Discretization - Types of Elements - Triangular, rectangular, 3D, and axis-symmetric Elements - Isoparametric Formulation - element properties – node numbering procedure - Convergence requirements – Generalized coordinates – Natural co-ordinates -Numerical Integration - Gaussian Quadrature - Interpolation Functions - shape functions for linear & quadratic models.		
UNIT – III	**DIRECT STIFFNESS METHOD**	**9 Periods**
Direct stiffness method - Element stiffness matrix - Global stiffness matrix - Boundary conditions – Nodal load vector – Static condensation – Simple problems.		
UNIT – IV	**TWO AND THREE DIMENSIONAL PROBLEMS**	**9 Periods**
Concept of sub, iso, super parametric elements – Gauss quadrature – Examples in one- and two-dimensional elements – Strain and Stress Computations - Plane stress CST Element, Plane Strain Rectangular Element - Isoparametric Formulation of the Plane Quadrilateral Element - Stress analysis of three-dimensional elements.		
UNIT – V	**AXISYMMETRIC ELEMENTS**	**9 Periods**
Analysis of solids of revolution under axisymmetric loading – Formulation of axisymmetric solid element–Simple examples - Introduction to Finite Element Software packages.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Krishnamoorthy C. S.,"**Finite Element Analysis Theory and Programming**", Tata McGraw Hill Education, 2017*
2	*Chandrupatla, T.R., and Belegundu, A.D., "**Introduction to Finite Element in Engineering**", Pearson, 2021.*

REFERENCES:

1	*Rajasekaran, S., "**Finite Element Methods in Engineering Design**", S Chand & Company, 2012.*
2	S.S. Rao, "***The Finite Element Method in Engineering***", Buttersworth - Heinemann publishing, 2017.
3	*P. Seshu, "**Textbook of Finite Element Analysis**", Prentice Hall India Pvt Ltd, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Recognize the basic principles, methods and steps in finite element method to solve real-world engineering problems effectively.	K3
CO2	Identify and apply the key principles of structural mechanics to structural elements.	K3
CO3	Conquer finite element problems, interpret shape functions and stiffness matrices.	K2
CO4	Formulate the isoperimetric elements and analyze the two and three-dimensional elements.	K2
CO5	Analyze and evaluate the axis-symmetric elements subjected to axisymmetric stresses.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	-	-	1	-
CO2	3	3	1	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	-	2	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	-	2	-
CO5	3	3	1	1	1	-	-	-	-	-	-	-	-	1	-
22CPE$03	3	3	1	1	1	-	-	-	-	-	-	-	-	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,5.1.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,3.1.1,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,5.1.1
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,5.1.1
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.1,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,5.1.1
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,3.1.1,3.3.1,3.4.1,4.1.1,4.1.2,4.1.3,5.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPE$04	ADVANCED CONCRETE DESIGN

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To create an awareness on yield line theory of slabs, design principles of Grid floors, ribbed slabs, bunkers, silos, slender columns, RC walls, bridges and deep beams.	
UNIT – I	**YIELD LINE THEORY OF SLABS AND INELASTIC BEHAVIOUR OF CONCRETE BEAMS**	**9 Periods**
Yield line theory - Assumptions made in Analysis – Analysis of Isotopically and Orthotopically Reinforced Slabs – Virtual Work Method and Equilibrium Method. Inelastic Behavior of Concrete Beams Moment Rotation Curves–Moment Redistribution		
UNIT – II	**DESIGN OF SPECIAL RC ELEMENTS**	**9 Periods**
Design of slender columns – Braced and Unbraced Columns – Design Considerations of RC walls–Design of Deep Beams.		
UNIT – III	**GRID FLOORS AND RIBBED SLABS**	**9 Periods**
Grid floors– Design Principles– Analysis of Grid Floor by Approximate Method–Ribbed Slabs–Analysis and Design of Ribbed Slab for Moment and Shear.		
UNIT – IV	**BUNKERS AND SILOS**	**9 Periods**
Design of Bunkers – Design of Silo – Detailing of Reinforcements.		
UNIT – V	**DESIGN OF BRIDGES**	**9 Periods**
Types of Bridges – IRC Loadings – Design of Single Span Slab Bridge Deck for Class A Loading–Design of T – Beam Bridge for Class AA Loading.		
Contact Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Varghese.P.C, **"Advanced Reinforced Concrete Design"**, Prentice Hall of India Private Ltd,NewDelhi,2010.*
2	*Krishnaraju,**"Advanced Reinforced Concrete Design–S.Iunits"**,C.B.S.,NewDelhi,2017.*

REFERENCES:

1	*IS456-2000, **"Indian standard code of practice for plain and reinforced concrete",** BIS, New Delhi.*
2	*SP34(1987), **"Hand book on Concrete Reinforcement and Detailing"**, BIS, New Delhi.*
3	*IRC6–2014, Standard Specifications and Code of Practice for Road Bridges*
4	*Pillai, S. U. and Menon, D, **"Reinforced Concrete Design"**, Tata McGraw Hill,2017*
5	*DayaratnamP.,**"Design of Reinforced Concrete Structures"**, Oxford & IBH publishing Co.Pvt.Ltd., 2011.*
6	*Subramanian N, **"Design of Reinforced Concrete Structures"**, Oxford University Press, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Analyse slabs using yield line theory and know the concepts of inelastic behavior of beams.	K2
CO2	Analyse and design slender columns, RC walls and deep beams as per Indian Standards.	K3
CO3	Design Grid floors and ribbed slabs using various methods.	K3
CO4	Design bunkers and silos.	K3
CO5	Perform analysis and design of bridges as per Indian Standards.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1	3	2	2	3	2	-	-	-	-	-	-	1	-	3	1
CO2	3	2	2	3	2	-	-	-	-	-	-	1	-	3	1
CO3	3	2	2	3	2	-	-	-	-	-	-	1	-	3	1
CO4	3	2	2	3	2	-	-	-	-	-	-	1	-	3	1
CO5	3	2	2	3	2	-	-	-	-	-	-	1	-	3	1
22CPE$04	**3**	**2**	**2**	**3**	**2**	-	-	-	-	-	-	**1**	-	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.2.1, 12.3.2
CO2	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.2.1, 12.3.2
CO3	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.2.1, 12.3.2
CO4	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.2.1, 12.3.2
CO5	1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 12.2.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	30	20	20	-	-	100
CAT2	30	30	20	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	30	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	30	20	20	-	-	100
ESE	30	30	20	20	-	-	100

22CPE$05	BASICS OF DYNAMICS AND ASEISMIC DESIGN OF STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	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	**FREE VIBRATION SYSTEM**	**9 Periods**
Concept of inertia and damping – Types of damping – Difference between static forces and dynamic excitation –Degrees of freedom – D'Alemberts Principles – SDOF idealization – Equations of motion of SDOF system of mass as well as base excitation – Free vibration of damped and undamped structures		
UNIT – II	**FORCED VIBRATION SYSTEM**	**9 Periods**
Forced vibration of damped and undamped structures – Response to harmonic excitation –Force Transmission - Periodic loading– Impulse and response to unit impulse– Measurement of Damping - Duhamel integral.		
UNIT – III	**MULTIPLE DEGREE OF FREEDOM SYSTEM**	**9 Periods**
Two degree of freedom system – Normal modes of vibration – Natural frequencies – Mode shapes – Introduction to MODF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).		
UNIT – IV	**ELEMENTS OF SEISMOLOGY AND SEISMIC DESIGN CONCEPT**	**9 Periods**
Elements of Engineering Seismology – Definitions, Introduction to Seismic hazard, Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading- Soil Structure Interaction – Liquefaction of soils – Concept of earthquake resistant design – Guide lines for seismic resistant construction		
UNIT – V	**DESIGN METHODOLOGY AND SEISMIC MITIGATION**	**9 Periods**
Importance of ductility – Methods of introducing ductility into RC structures - Response and design spectra – Design earthquake - IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquakes on structures.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Chopra, A.K., "**Dynamics of structures – Theory and Applications to Earthquake Engineering",** Fifth Edition, Pearson Education, 2017.*
2	*Pankaj Agarwal & Manish Shrikhande, "**Earthquake Resistant Design of Structures**", PHI Learning privated Limited, NewDelhi, 2011.*

REFERENCES :

1	*Damodarasamy S. R, Kavitha S, "**Basics of Structural Dynamics and Aseismic Design**", PHI Learning Private limited, New Delhi, 2009.*
2	*Clough R.W, and Penzien J, "**Dynamics of Structures**", Second Edition, CBS publishers, 2015*
3	*Mario Paz, "**Structural Dynamics – Theory and Computations**", Third Edition, CBS publishers, 2012*
4	*S.K.Duggal, "**Earth Quake Resistant Design of Structures**", Oxford university Press, 2013.*
5	*C. A. Brebbia, "**Earthquake Resistant Engineering Structures VIII**",WIT Press, 2011*
6	*IS 4326: 2013 "Earthquake Resistant Design and Construction of Buildings – Code of Practice"* *IS 1893: 2016 "Criteria for Earthquake Resistant Design of Structures – Part 1 General Provisions and Buildings"* *IS 13920:2016 "Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice".*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the dynamic response of SDOF System under free vibration	K2
CO2	Determine response of SDOF system under forced Condition	K2
CO3	Illustrate the mode shapes of MDOF System subjected to different types of vibration	K3
CO4	Explain the behaviour of structure under seismic load and its design concept	K2
CO5	Apply Indian codal provisions in the planning, design and detailing of structures	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-	3	2	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	3	2	-
22CPE $05	3	2	1	1	-	-	-	-	-	-	-	1	3	2	-
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.4.4,3.2.1,3.2.3,4.1.4
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.4.4,3.2.1,3.2.3,4.1.4
CO3	1.1.1,1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.4.1,2.4.4,4.1.4,4.3.3
CO4	1.1.1,1.1.2,1.2.1,2.1.2
CO5	1.1.1,1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.2.4,2.4.4,3.1.4

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPE$06	DESIGN AND DETAILING OF CONCRETE AND STEEL STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	3	0	0	3

Course Objectives	To gain familiarity with the codal provisions governing the design and detailing of reinforced concrete and steel structures.

PART A

Detailed design and detailing of the following concrete structures:

1. Beams – Simply supported, Continuous, Cantilever. (Singly reinforced, Doubly reinforced and T beams)
2. Slabs – Simply supported, Continuous. (One way and Two way slabs)
3. Footings – Isolated and Combined footings (Rectangular, Trapezoidal)
4. Retaining Wall - Cantilever and Counterfort types.
5. Flat slabs.

PART B

Detailed design and detailing of the following Steel structures:

1. Column base – Slab base and Gusseted base.
2. Seated connections – stiffened and unstiffened.
3. Moment resistant connections.
4. Welded Plate Girder
5. Simple trusses with connections.

Contact Periods:
Lecture: 45 Periods Tutorial: 00 Periods Practical: 00 Periods Total: 45 Periods

Question Paper Pattern:
Question paper shall consist of two questions from each part.
Part A consists of 60 marks and Part B consists of 40 marks and the students have to answer one question from each part.

TEXT BOOKS:

1	*Pillai and Menon, "**Reinforced Concrete Design**", McGraw Hill Education (India) Private Ltd., 2016.*
2	*Duggal .S.K, "**Design of steel structures**", Tata Mcgraw Hill Publishing company Ltd, 2009.*

REFERENCES:

1	*Ramchandra, "**Limit State Design**", Standard Book House, Delhi-6, 2005.*
2	*Sinha.S.N, "**Reinforced Concrete Design**", Tata McGraw Hill publishing company Ltd., 2005.*
3	*Krishna Raju N and Pranesh, R.N., "**Reinforced Concrete Design – IS 456 – 2000 Principles and Practice**", New Age International Publishers, New Delhi, 2003.*
3	*N.KrishnaRaju, "**Structural Design and Drawing**", University Press, 2005.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	**Bloom's Taxonomy Mapped**

CO1	Design and develop detailed drawings for RCC beams and slabs.	K3
CO2	Execute detailed design and drawing of footings and retaining walls.	K3
CO3	Prepare design and detailing drawings for flat slabs.	K3
CO4	Design and draft various types of seated and moment-resistant connections.	K3
CO5	Design and illustrate the drawings of plate girders and trusses.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1
CO2	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1
CO3	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1
CO4	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1
CO5	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1
22CPE $06	2	1	1	1	-	-	-	-	-	1	-	-	3	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,3.1.4,3.1.6,4.1.1,10.3.1
CO2	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,3.1.4,3.1.6,4.1.1,10.3.1
CO3	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,3.1.4,3.1.6,4.1.1,10.3.1
CO4	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,3.1.4,3.1.6,4.1.1,10.3.1
CO5	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,3.1.4,3.1.6,4.1.1,10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	10	80	-	-	-	100
CAT2	10	10	80	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	10	80	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	10	80	-	-	-	100
ESE	10	10	80	-	-	-	100

22CPE$07	BRIDGE ENGINEERING					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
	NIL	**PE**	**3**	**0**	**0**	**3**
Course Objective	To familiarize with types and choice of bridges and understand the design concepts of bridge structures, culverts, bearing and sub structures.					
UNIT – I	**INTRODUCTION**					**9 Periods**
Components of a Bridge Structure – Inspection and Site Investigations for a Bridge – Determination of Linear Waterway, Design Discharge and Scour Depth – Economical Span – Types and Choice of Bridges- IRC Loading Classifications.						
UNIT – II	**SLAB BRIDGE AND T- BEAM BRIDGES**					**9 Periods**
Slab Bridge - Distribution of Concentrated Loads by IRC and Pigeaud's Method – Design of T- Beam Bridge – Design of Main Girder– Design of Cross Girders – Load Distribution by Courbon's Method – Skew slab Bridge.						
UNIT – III	**BRIDGE AND BOX CULVERT**					**9 Periods**
Single Span Rigid Frame Bridge (Barrel or Slab Type only) – Box Culvert (Single Vent only) - Balanced Cantilever RC Bridges– Design of Articulations.						
UNIT – IV	**PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES**					**9 Periods**
Introduction to Design of PSC bridges – PSC girders – Introduction to Design of Steel Bridges - Plate Girder Bridges – Box Girder Bridges – Truss Bridges – Vertical and Horizontal Stiffeners.						
UNIT – V	**SUBSTRUCTURE, BEARING AND MAINTENANCE OF BRIDGES**					**9 Periods**
Bearings – Types, Functions – Simple Problems – Substructures – Abutment, Pier – Materials-Stability requirements - Rebuilding of Bridges – Replacement of Pier Tops, Girders, Side Sleeving and end launching methods – Joints in Bridges - Case Studies.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*Krishna Raju.N " **Design of Bridges"**, Oxford and IBH Publishing Co., New Delhi, 5th Edition 2015.*
2	*Ponnuswamy.S, **"Bridge Engineering**", 3rd edition, Tata McGraw Hill Publishing Co., Ltd, New Delhi, 2017.*

REFERENCES:

1	*Jagadeesh. T.R. and Jayaram. M. A., **"Design of Bridge Structures",** Second Edition, Prentice Hall of India Pvt. Ltd. 2009*
2	*Richard M. Barker & Jay A. Puckett, **"Design of Highway Bridges",** John Wiley & Sons, Inc., 2007*
3	*Johnson Victor, D. **"Essentials of Bridge Engineering"**, Sixth Edition, Oxford and IBH Publishing Co. New Delhi, 2018.*
4	*Demetrius E. Tonias, F. ASCE, Jim J. Zhao, "**Bridge Engineering : Design, Rehabilitation, and Maintenance of Modern Highway Bridges**", 3rd Edition, McGraw Hill, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply IRC codal provisions in the design of bridges	K2
CO2	Analyze and design short span bridges	K3
CO3	Analyze and design long span bridges	K3
CO4	Design of PSC bridges and steel bridge	K3
CO5	Design of the sub structures.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	-	-	-	-	-	1	1	-	2
CO2	3	2	1	1	1	3	-	-	-	-	-	1	1	-	2
CO3	3	2	1	1	1	3	-	-	-	-	-	1	1	-	2
CO4	3	2	1	1	1	3	-	-	-	-	-	1	1	-	2
CO5	3	1	1	1	1	3	-	-	-	-	-	1	1	-	2
22CPE$07	2	2	1	1	1	3	-	-	-	-	-	1	1	-	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.2.2,2.2.3, 3.1.5, 3.3.2,4.1.4,4.2.1, 4.3.1,5.1.1, 5.1.2, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO2	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO3	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO4	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO5	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 6.1.1, 6.2.1, 12.2.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$08	EARTHQUAKE ENGINEERING					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**PE**	**3**	**0**	**0**	**3**

Course Objective	To impart the basic principles for seismic design and construction of structures in accordance with the provisions of Indian Standard Codes	
UNIT – I	**SEISMOLOGY**	**9 Periods**
Elements of Engineering Seismology – Structure of Earth - Causes of Earthquakes - Plate Tectonic Theory- Continental Drift Theory- Elastic Rebound Theory - Seismic Waves - Magnitude, intensity and energy release – Indian Seismology –Earthquake History – Seismic Zone Map of India – Seismographs – Seismogram – Accelerograph – Prominent Earthquakes in India.		
UNIT – II	**SEISMIC DESIGN CONCEPTS**	**9 Periods**
Concept of Earthquake Resistant Design –Strong Column Weak Beam Concept – Guide Lines for Seismic Resistant Construction – Effects of Structural Irregularities – Seismic Resistant Building Architecture, Response and Design Spectra, Design Earthquake – Concept of Peak Acceleration – Site Specific Response Spectrum, Planning Aspects, Liquefaction of Soils, Methods of Introducing Ductility into RC structures.		
UNIT – III	**DESIGN METHODOLOGY**	**9 Periods**
Introduction to Methods of Seismic Analysis – Equivalent Static analysis IS 1893 provisions – Design Horizontal Seismic Coefficient – Design Base Shear – Distribution – Idealization of Building frames - Seismic Analysis and Modeling – Determination of Lateral Forces – Equivalent Static Lateral Force method – Response Spectrum Method.		
UNIT – IV	**ASEISMIC CODAL PROVISIONS**	**9 Periods**
Behaviour of Unreinforced Masonry and Reinforced Masonry, RC bands, Vertical Reinforcement, Openings, Provisions of IS 4326, Repairs and Strengthening of Masonry and RC Members. Ductile Detailing of Reinforcement in RC Buildings as per IS 13920.		
UNIT – V	**MODERN TECHNIQUES**	**9 Periods**
Introduction to Earthquake Resistant modern techniques - Base Isolation Techniques – Elastometric, Sliding, Combined - Seismic Dampers, Friction Dampers, Visco Elastic Dampers. Vibration Control Measures – Important Points in Mitigating Effects of Earthquakes on Structures.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Chopra, A.K.,* ***"Dynamics of structures – Theory and Applications to Earthquake Engineering"****, Pearson Education, 2022.*
2	*S.K.Duggal,* ***"Earth Quake Resistant Design of Structures"****, Oxford university Press, 2013.*

REFERENCES:

1	*Pankaj Agarwal & Manish Shrikhande,* ***"Earthquake Resistant Design of Structures"****,Prentice Hall of India, NewDelhi, 2006.*
2	*Chopra A K, "***Dynamics of Structures - Theory and Applications to Earthquake Engineering***", Pearson Education Ltd., 2017.*
3	*Y-X. Hu, S-C. Liu, W. Dong, "***Earthquake Engineering***", CRC Press, 2019.*
4	*Indian Standard Codes: IS: 1893:2016, IS: 4326 :2013, IS 13828:1993(R2008) and IS: 13920:2016, Bureau of Indian Standards, New Delhi.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Evaluate the causes and effects of earthquakes.	K2
CO2	Summarize the design concepts for earthquake resistant structures.	K2
CO3	Analyse the structures subjected to seismic loads.	K2
CO4	Apply Indian codal provisions in the planning, design and detailing of structures.	K3
CO5	Execute vibration control techniques and other modern techniques in various structures.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	-	-	-	-	-	1	-	1	2
CO2	3	2	1	1	1	3	-	-	-	-	-	1	-	1	3
CO3	3	2	1	1	1	3	-	-	-	-	-	1	1	1	3
CO4	3	2	1	1	1	3	-	-	-	-	-	1	1	1	3
CO5	3	1	1	1	1	3	-	-	-	-	-	1	1	1	3
22CPE$08	3	2	1	1	1	3	-	-	-	-	-	1	1	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.2.2,2.2.3, 3.1.5, 3.3.2,4.1.4,4.2.1, 4.3.1,5.1.1, 5.1.2, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO2	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO3	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO4	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3,2.4.1, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO5	1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2,2.1.3,2.2.3, 3.1.5, 3.2.2, 3.3.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 6.1.1, 6.2.1, 12.2.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$09	MAINTENANCE AND REHABILITATION OF STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To make the students to inspect the distressed structures and apply the suitable repair materials and rehabilitation techniques.	
UNIT – I	**MAINTENANCE AND REPAIR STRATEGIES**	**9 Periods**
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	**REPAIR FOR DISTRESSED MEMBERS**	**9 Periods**
Types, Causes and effects of cracks – effects due to corrosion, climate, temperature, chemicals and aggressive environment - Cover thickness requirements - Repairs to overcome deflection, cracking, chemical disruption, corrosion, wear, fire, leakage and marine exposure.		
UNIT – III	**MATERIALS AND SPECIAL CONCRETE FOR REPAIR**	**9 Periods**
Selection of Materials- Admixtures used as repair materials - Concrete chemicals - Expansive cement - Ferro cement - FRP sheet, Fibre composites - special concrete: Sulphur infiltrated concrete - High strength concrete - Foamed concrete – Geopolymer concrete, Reactive powder concrete - Vacuum concrete.		
UNIT – IV	**TECHNIQUES FOR REPAIR AND CORROSION PROTECTION METHODS**	**9 Periods**
Non-destructive Testing Techniques – load test for stability - Epoxy injection - Guniting and Shotcreting – Shoring and Underpinning - Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.		
UNIT – V	**REHABILITATION AND STRENGTHENING OF STRUCTURES**	**9 Periods**
Strengthening of Super Structures - Jacketing - Reinforcement addition, Plating, Conversion to composite construction - Post stressing - Strengthening of substructures – Case studies: Transportation of structures from one place to other - Demolition Techniques – Engineered demolition methods – automated demolition techniques.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Dr. B. Vidivelli, **"Rehabilitation of concrete structures"**, Standard Publishers, 2021*
2	*Hand Book on **"Repairs and Rehabilitation of RCC Buildings"** Central Public Works Department, Govt. ofIndia, New Delhi, 2011.*

REFERENCES:

1	*Bhattecharjee, **"Concrete Structures Repair Rehabilitation and Retrofitting"**, CBS Publishersand Distributors, New Delhi, 2019.*
2	*Poonam I. Modi, Chirag N. Patel,**"Repair & Rehabilitation of Concrete Structures"**, PHILearning Pvt. Ltd., New Delhi, 2016.*
3	*Dr. R. Saravanan R. Dineshkumar, **"Repair and Rehabilitation of Structures"**, Lakshmi Publications, Chennai, 2018.*
4	*M. S. Shetty, **"Concrete Technology – Theory and Practice"**, S. Chand and Company, NewDelhi, 2019.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the causes of deterioration and evaluate a damaged structure.	K3
CO2	Do repair works for distressed members in a structures.	K3
CO3	Propose the appropriate materials and concrete for various repair conditions.	K3
CO4	Execute various techniques for repair and protection methods.	K3
CO5	Rehabilitate and strengthen the various elements of a structure subjected to deterioration.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**	**PSO 3**
CO1	2	2	1	1	-	2	-	-	1	-	-	1	2	3	3
CO2	2	2	1	-	-	-	-	-	1	-	-		2	3	3
CO3	2	1	1	-	-	-	-	-		-	-		3	3	3
CO4	2	2	1	1	-	2	-	-	1	-	-	1	2	3	3
CO5	2	2	1	1	-	2	-	-		-	-	1	2	3	3
22CPE$09	2	2	1	1	-	2	-	-	1	-	-	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.4.4,3.1.5,4.1.1,4.1.3,4.3.1,6.1.1,12.1.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,3.1.5
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,3.1.5
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,,2.4.2,2.4.4,3.1.5,4.1.1,4.1.3,4.3.1,6.1.1,12.1.1
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,,2.4.2,2.4.4,3.1.5,4.1.1,4.1.3,4.3.1,6.1.1,12.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$10	DESIGN AND DETAILING OF IRRIGATION AND ENVIRONMENTAL STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To design and detail the different Irrigation Engineering and Environmental Engineering structures
PART A :	**IRRIGATION ENGINEERING**
Tank Surplus Weir (Type A and D) -Tank Sluice with a Tower Head - Direct Sluice - Notch type Canal Drop - Canal Regulators and river regulators- Cross-Drainage Works (Syphon Aqueduct type II & III)	
PART B :	**ENVIRONMENTAL ENGINEERING**
Intake tower - Screening device - Primary sedimentation tank – Clari-flocculator - Slow and Rapid sand filters – Secondary settling tanks – Trickling filter – Activated sludge process – Sludge digestion tank - Septic tank with dispersion trench and soak pit – Infiltration gallery.	
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**	

TEXT BOOKS :

1	*Sathya Narayana Murthy Challa, **“Water Resources Engineering Principles and Practice”**, New Age International (P) Ltd., New Delhi, 2009.*
2	*Rangwala.S.C, **“Water Supply and Sanitary Engineering”**, Charotar Publishing, New Delhi, 2016.*

REFERENCES :

1	*Santosh Kumar Garg, **“Irrigation Engineering and Hydraulics Structures”**, Khanna Publications Pvt. Ltd, New Delhi, 2017.*
2	*Birde.G.S and Birde .J.S, **“Water Supply and Sanitary Engineering”**, Dhanpat Rai Publications Pvt. Ltd, New Delhi, 2018.*
3	*Punmia.B.C. and Pande B.B. Lal, **“Irrigation and Water Power Engineering”**, Laxmi Publications Pvt. Ltd, New Delhi, 2021.*
4	*Garg. S. K., “**Water Supply Engineering**”, Khanna Publishers, Delhi, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Design the different Hydraulic structures in the field.	K3
CO2	Prepare the drawings of Irrigation Structures.	K3
CO3	Design the different Environmental Engineering structures in the field.	K3
CO4	Prepare the drawings of Environmental Structures.	K3
CO5	Discuss the importance of the Irrigation and Environmental Structures in real life.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2
CO2	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2
CO3	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2
CO4	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2
CO5	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2
22CPE$10	3	2	3	-	1	-	-	-	-	-	-	-	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.1.3, 3.1.6,3.2.1, 3.2.3, 3.3.1,3.4.1, 3.4.2, 5.1.1, 5.2.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.1.3, 3.1.6,3.2.1, 3.2.3, 3.3.1,3.4.1, 3.4.2, 5.1.1, 5.2.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.1.3, 3.1.6,3.2.1, 3.2.3, 3.3.1,3.4.1, 3.4.2, 5.1.1, 5.2.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.1.3, 3.1.6,3.2.1, 3.2.3, 3.3.1,3.4.1, 3.4.2, 5.1.1, 5.2.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.1.3, 3.1.6,3.2.1, 3.2.3, 3.3.1,3.4.1, 3.4.2, 5.1.1, 5.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	10	80	-	-	-	100
CAT2	10	10	80	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	10	10	80	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	10	80	-	-	-	100
ESE	10	10	80	-	-	-	100

22CPE$11	ENVIRONMENTAL LEGISLATIONS IN INDIA

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To impart knowledge on National and international Environmental Policies and to understand the management of Industrial solid waste and E- waste.	
UNIT – I	**THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974**	**9 Periods**
Definitions - Salient Features - Powers & Functions of Regulatory Agencies – Responsibilities of Occupier, Provisions relating to Prevention & Control-Procedures to obtain consent-Monitoring and Compliance Mechanisms-Legal Provision for violation of Water Act- Case Studies on Water Polluting Industries-Textile Dyeing, Paper Mills-Electroplating, Starch Industries - Inventorization of New Water Polluting Industry and its management.		
UNIT – II	**THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT, 1981**	**9 Periods**
Definition-Salient features- Powers & functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of Occupier, Provisions relating to Prevention & Control-Procedures to obtain consent Monitoring and compliance mechanisms- Legal Provision for Violation of Air Act- Case studies on Air Polluting Industries-Foundries, Cement, Thermal power plants- Inventorization of New Air polluting Industry and its management.		
UNIT – III	**THE ENVIRONMENT (PROTECTION) ACT, 1986**	**9 Periods**
Genesis of the Act-Salient features-Role of Central Government-Various Notifications and Rules – Prohibition on Import of Genetically Modified Organisms-Chemicals-Hazardous Wastes- Batteries management-Restriction on Ozone Depleting Substances-EIA notification-Sitting of Industries-State level EIA Authorities-Eco-mark-Control on Noise Pollution-Coastal Regulations- Monitoring and Compliance Mechanisms-Role of National Green Tribunals (NGT), Environmental Courts & Public interest litigation -Case studies.		
UNIT – IV	**REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT**	**9 Periods**
Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes-Municipal solid wastes-Salient Features-Responsibilities of Occupier/Generator/Local Bodies/PCBs- Monitoring and Compliance Mechanisms-consent clearance, Authorization, Registration procedures for industry specific-Issues & Challenges-Best Practices - Case Studies on Lead Refining, Engineering Units, Hospitals, Plastic Units, Municipal Landfills.		
UNIT – V	**ELECTRONIC WASTE (MANAGEMENT AND HANDLING) RULES**	**9 Periods**
Definition-Environmental & Occupational Health hazards of E-Waste-Salient features of E-waste Rules-Extended Producers Responsibility-Issues and Challenges –Compliance and Consent Clearance Mechanisms-Best Practices of E-waste management-Case studies on E-waste recycling units, Bulk Consumers, Collection Centers.		
Contact Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

TEXT BOOKS:

1	*P.Leelakrishnan, **"Environmental Law in India"**, Lexis Nexis 6th edition 2021.*
2	*Shyam Divan and Armin Roseneranz, **"Environmental law and policy in India"**, Oxford University Press, New Delhi, 2017*

REFERENCES:

1	*CPHEEO, **Manual on Municipal Solid waste management**, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2016*
2	*K.R.Gupta. **“Environmental legislation in India”**, Atlantic 2006.*
3	***E- Waste (Management) Rules**, 2022, Central Pollution Control Board, India*
4	*Vesilind P.A., Worrell W and Reinhart, **“Solid waste Engineering”**, Thomson Learning Inc., Singapore, 2012*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Apply the water act regulations in various Industries.	K2
CO2	Implement air pollution control methods based on regulations.	K2
CO3	Plan and take decisions related to Environmental policies.	K2
CO4	Manage Industrial solid waste based on regulations.	K2
CO5	Categorize and manage the handling of E- waste.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	2	2	2	-	1	1	-	1	-	-	-	1	1	-
CO2	-	2	2	2	-	1	1	-	1	-	-	-	1	1	-
CO3	-	2	2	2	-	1	1	-	1	-	-	-	1	1	-
CO4	-	2	2	3	-	1	2	-	1	-	-	1	1	1	-
CO5	-	2	2	3	-	1	2	-	1	-	-	1	1	1	-
22CPE$11	-	2	2	3	-	1	2	-	1	-	-	1	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1		2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO2		2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO3		2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO4		2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2
CO5		2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom’s Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$12	INDUSTRIAL WASTEWATER MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To understand the qualitative and quantitative assessment of industrial wastewater and the principles of waste minimization technique on environmentand the effect of disposal of various industrial wastewater and their treatmenttechnologies.	
UNIT – I	**SOURCES OF INDUSTRIAL WASTE**	**9 Periods**
Industrial waste survey – Sources & effects measurement of Industrial wastewater Flow-generation rates - Sampling and preservation of samples for analysis -Wastewater Characterization-Toxicity of industrial effluents- Prevention vs Control of Industrial Pollution – Source reduction techniques - effect of Industrial Effluents on Streams, Sewer and Human health – Industrial scenario in India – Industrial activity and environment.		
UNIT – II	**TREATMENT AND CONTROL TECHNOLOGIES**	**9 Periods**
Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal removal – Adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation - Evaporation – Ion Exchange – Membrane Technologies – management of RO reject - Nutrient removal – Implementing and promoting pollution prevention programs in industries.		
UNIT – III	**INDUSTRIAL WASTEWATER DISPOSAL**	**9 Periods**
Individual and Common Effluent Treatment Plants – Advantages – Joint treatment of Industrial and domestic wastewater – Recirculation of Industrial Waste – Disposal of effluent into streams, lakes and oceans and associated problems – Effluent disposal methods – Sludge disposal technique.		
UNIT – IV	**INDUSTRIAL PROCESS AND TREATMENT-I**	**9 Periods**
Industrial manufacturing process and source, wastewater characteristics, effects and treatment methods of liquid waste from Textile industry - Sugar mill– Coal and Gas based power plants – Fertilizer industry – Dairy and food processing industries.		
UNIT – V	**INDUSTRIAL PROCESS AND TREATMENT-II**	**9 Periods**
Industrial manufacturing process and source, wastewater characteristics, effects and treatment methods of liquid waste from Pulp and Paper mill - Iron and Steel industries - Automobile Industry- Pharmaceutical industry- Industrial estates and Industrial Clusters.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

TEXTBOOKS:

1	*Garg S.K., "**Sewage Disposal and Air Pollution Engineering**", Khanna Publishers, New Delhi, 2018*
2	*Patwardhan, A.D., "**Industrial Waste Water Treatment**", PHI Learning, 2017*

REFERENCES:

1	*Eckenfelder, W.W., "**Industrial Water Pollution Control",** McGraw-Hill, 2014.*
2	*Soli. J Arceivala, Shyam. R Asolekar "**Wastewater Treatment for Pollution Control and Reuse**", McGraw-Hill, 2006.*
3	*Frank Woodard, **"Industrial waste treatment Handbook**", Butterworth Heinemann, New Delhi, 2006.*
4	*Nemerow N. L., "**Industrial Water Pollution",** Addison - Wesley Publishing Company Inc., USA, 2007.*
5	*Mahajan S. P. **"Pollution Control in process industries**", Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008.*
6	*Metcalf and Eddy, "**Waste Water Engineering- Treatment and Reuse**", Tata Mc-Graw Hill Company, New Delhi 2007*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Carry out qualitative and quantitative assessment of industrial wastewater	K2
CO2	Analyze the principles of waste minimization techniques	K2
CO3	Identify and select appropriate disposal methods	K2
CO4	Manage the effluent treatment from major industries	K2
CO5	Examine the manufacturing and treatment processes and the concept of industrial clusters	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	1	1	-	-	1	2	-	-	-	-	-	1	3	-
CO2	2	1	1	-	-	1	2	-	-	-	-	-	1	3	-
CO3	2	2	3	1	-	2	2	-	-	-	1	1	1	3	1
CO4	3	2	3	1	-	3	3	-	-	-	1	1	1	3	1
CO5	3	2	3	1	-	3	3	-	-	-	1	1	1	3	1
22CPE$12	**2**	**2**	**3**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**1**	**1**	**1**	**3**	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	2.2.4,2.4.3,3.1.5,4.1.1,4.1.2,6.1.1
CO2	2.1.3,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.6,4.1.1,4.1.2,4.1.4,6.1.1,7.1.2,
CO3	1.2.1,1.3.1,2.1.2,2.2.3,2.2.4,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO4	1.2.1,1.3.1,2.1.2,2.2.3,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO5	1.3.1,2.2.3,2.4.3,3.1.5,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$13	SUSTAINABLE ENGINEERING AND TECHNOLOGY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To establish a clear understanding sustainable development, methods & tools and alsothe role and impact of various aspects of engineering decisions on environmental, societal, and economic problems.	
UNIT – I	**INTRODUCTION TO SUSTAINABILE DEVELOPMENT**	**9 Periods**
Sustainability - Introduction, Need and concept of sustainability, Social environmental and economic sustainability concepts. Evolution of Sustainable Development – Brundtland Commission, 1987, Agenda 21, MDGs and SDGs; United Nations summits and their outcomes. Multi lateral Environmental Agreements, Conventions and Protocols. Challenges for Sustainable Development. Clean Development Mechanism (CDM). An overview of Sustainable Development Goals and Targets: Global and Indian perspective.		
UNIT – II	**ENVIRONMENTAL ISSUES**	**9 Periods**
Local Environmental Issues- Solid waste, impact of solid waste on natural resources, zero wasteconcept and three R concept, Air Pollution, water pollution sources and Effects. Global Environmental Issues- Resource degradation: deterioration of water resources, land degradation, air pollution, climate change and global warming, ozone layer depletion, carbon footprint, carbon trading.		
UNIT – III	**LIFE CYCLE ANALYSIS AND ENVIRONMENT IMPACT ASSESSMENT**	**9 Periods**
Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Environment Impact Assessment (EIA) - Procedures of EIA in India. Environmental legislations in India - Water Act, Air Act.		
UNIT – IV	**SUSTAINABLE HABITAT**	**9 Periods**
Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainable cities, Sustainable transport.		
UNIT – V	**SUSTAINABLE ENERGY SOURCES**	**9 Periods**
Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans, Geothermal energy.		
Contact Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

TEXTBOOKS:

1	*Allen, D. T. and Shonnard, D. R., "**Sustainability Engineering: Concepts, Design and Case Studies**", Prentice Hall, 2011.*
3	*Bradley. A.S; Adebayo, A.O., Maria, P. "**Engineering applications in sustainable design and development**", Cengage learning, 2015.*

REFERENCES:

1	*ECBC Code 2007, "**Bureau of Energy Efficiency**", New Delhi Bureau of Energy Efficiency Publications*
2	*Ni bin Chang, "**Systems Analysis for Sustainable Engineering: Theory and Applications**", McGraw-Hill Professional, 2010.*
3	*Bhavik R. Bakshi,"**Sustainable Engineering: Principles and Practice**",Cambridge University Press, 2019*
4	*https://www.globalreporting.org/*
5	*https://www.sustainabilityconsortium.org/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Summarize the different environmental agreements and protocols for the sustainable development.	K2
CO2	Identify different types of local and global environmental issuesand their sustainable solutions	K2
CO3	Perform Life Cycle Analysis and Environment Impact Assessment	K2
CO4	Apply the concepts of sustainable habitat while designing an infrastructure	K2
CO5	Relate the different renewable energy resources and methods to implement green technology	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	1	3	-	1	-	1	1	1	3	-
CO2	2	1	2	-	-	2	3	-	-	-	1	1	2	3	1
CO3	2	1	2	-	-	2	3	-	-	-	-	1	2	3	1
CO4	3	1	2	1	-	3	3	-	-	-	1	1	2	3	2
CO5	2	-	1	-	-	2	3	-	-	-	1	1	2	3	1
22CPE$13	**2**	**1**	**2**	**1**	-	**2**	**3**	-	**1**	-	**1**	**1**	**2**	**3**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	2.2.4,2.4.3,3.1.5,4.1.1,4.1.2,6.1.1
CO2	2.1.3,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.6,4.1.1,4.1.2,4.1.4,6.1.1,7.1.2,
CO3	1.2.1,1.3.1,2.1.2,2.2.3,2.2.4,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO4	1.2.1,1.3.1,2.1.2,2.2.3,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO5	1.3.1,2.2.3,2.4.3,3.1.5,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$14	FUNDAMENTALS OF REMOTE SENSING AND GIS APPLICATIONS

PREREQUISITES		CATEGORY	L	T	P	C
NIL		PE	3	0	0	3
Course Objectives	Familiarize the concepts and principles of various components of remote sensing, GIS and its practical applications in the fields of civil engineering, water resources, land use studies, soil science, Agriculture, forestry and Oceanography.					
UNIT – I	**PRINCIPLES OF REMOTE SENSING**					**9 Periods**
Definition , Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra-Red (IR), Near IR, Middle IR , Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law.						
UNIT – II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIALS**					**9 Periods**
Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non-selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces- Spectral Signature – Spectral Signature curves – EMR interaction with water, soil and Earth Surface.						
UNIT – III	**OPTICAL AND MICROWAVE REMOTE SENSING AND IMAGE PROCESSING**					**9 Periods**
Satellites - Classification – Based on Orbits – Sun Synchronous and Geo Synchronous – Based on Purpose – Earth Resources Satellites, Communication Satellites, Weather Satellites, Spy Satellites – Satellite Sensors - Resolution – Spectral, Spatial, Radiometric and Temporal Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites - Radar – Speckle – Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometrical characteristics of digital image processing – Pre-processing image enhancement–Filtering–Classification.						
UNIT – IV	**GEOGRAPHIC INFORMATION SYSTEM**					**9 Periods**
GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters.						
UNIT – V	**SATELLITE IMAGERY AND GIS APPLICATIONS**					**9 Periods**
Application of satellite imagery – Merits – Limitations – Comparison with aerial photographs – Visual interpretation of satellite imagery – Elements of interpretation – Interpretation keysGPS and its Applications- Application of remote sensing and GIS in Surveying, Water resources exploration – Land use/Land cover studies – Geology –Agriculture, Disaster Management, Coastal zone Management and Environmental Engineering.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Period Practical: 0 Period Total: 45 Periods**						

TEXT BOOKS:

1	*A M Chandra, S.K.Ghosh,* ***"Remote Sensing and Geographical Information system"****, Narosa, Publishing house New Delhi, 2006.*
2	*Patel A.N and Surendrasingh,* ***"Remote Sensing Principles and applications"****, Scientific Publishers, Jodhpur , 2001*
3	*AnjiReddy,* ***"Remote Sensing and Geographical Information system"****, BS Publications 2014*

REFERENCES:

1	*M.G. Srinivas, (Edited by)* ***" Remote sensing applications"****, Narosa publishing House, 2001.*
2	*Thomas M.Lille sand & Raiph W.Kiefer,* ***"Remote sensing and Image Interpretation"****, John Wiley Sons,2004*
3	*Burrough P.A, "****Principles of GIS for land resources assessment"****, Oxford, 2002.*
4	*S.C.Bhatia, "****Fundamentals of Remote sensing****", Atlantic Publishers & Distributions (P) Ltd, 2008.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Know the principles and methods of remote sensing.	K1
CO2	To gain the knowledge on electromagnetic radiation waves interaction with materials.	K2
CO3	Apply the concept of satellite remote sensing, Data acquisition and image processing.	K2
CO4	Categorize the hardware and software of GIS.	K3
CO5	Utilize the application of GIS in the areas of water resources, land use studies, soil science, Agriculture, forestry and Oceanography.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**P O2**	**P O3**	**P O4**	**P O5**	**P O6**	**P O7**	**P O8**	**P O9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	2	2	-	1	-	-	1	-	-	-	-	-	1	2	-
CO2	2	-	-	1	-	-	1	-	-	1	-	-	1	1	-
CO3	2	1	1	-	-	1	-	-	-	1	-	-	1	2	-
CO4	-	2	1	1	1	1	1	-	-	1	1	1	1	2	-
CO5	2	1	1	-	1	1	1	-	-	1	1	1	1	2	-
22CP E$14	2	2	1	-	1	1	1	-	-	1	1	1	1	2	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,2.2.2,4.1.4,7.2.2.
CO2	1.3.1,4.3.1,7.1.2,10.1.1.
CO3	1.3.1,2.1.3, 2.2.4,3.4.2, 6.1.1,7.1.2, 7.2.2,10.1.1.
CO4	2.2.2,3.1.1 ,5.1.1,6.1.1,7.1.1,7.1.2,7.2.2,10.1.1.
CO5	1.2.1,2.1.2,3.1.1,6.1.1,6.2.2,7.1.1,7.1.2,7.2.2,10.1.1.

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	40	40	20	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$15	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To impart knowledge on mode of irrigation practiced in Tamil Nadu, functions and design of different hydraulic structures	
UNIT – I	**IRRIGATION PRACTICE**	**9 Periods**
Necessity – Advantages and types of irrigation – methods of irrigation – Soil- water- plant relations - main crops and their seasons – saline, alkaline soils and their reclamation – root zone depth – Duty and Delta – relationship – Factors affecting duty – optimum utilization of water – Consumptive use of water by a crop – Estimation - assessment of irrigation water – Irrigation efficiencies – Problems.		
UNIT – II	**DIVERSION HEAD WORKS**	**9 Periods**
Functions of diversion head works – Types – Layout of diversion head works – Component parts – functions - Weir – types – Causes of failure of weirs and their remedies – Design of impervious floor by Creep theories – Bligh's theory - Khosla's theory – Design of a vertical drop weir – Design principles for undersluices.		
UNIT – III	**ARCH, BUTTRESS AND EARTH DAMS**	**9 Periods**
Types of Arch dams – forces acting on it – advantages - Buttress dams – types and uses of buttress dams. Earth dam – types of earth dams – Method of construction - Section of earth dams – Causes of failure of earth dams – criteria for safe design of earth dams –Crosssections of earth dam according to materials – seepage control measures in earth dam		
UNIT – IV	**CANAL REGULATION WORKS**	**9 Periods**
Canal falls – types – Design of vertical drop fall – Functions of Regulators - Design of head and cross regulators – Cross drainage works – types of cross drainage works – Selection of suitable types of cross drainage works – Classification of aqueducts and syphon aqueducts – Design procedure of cross drainage works.		
UNIT – V	**WATER LOGGING, DRAINAGE AND RIVER CONTROL**	**9 Periods**
Water logging – Causes and effects of water logging – Remedial measures– Land Drainage – Advantages – Types of drainage system – layout of tile drainage. Rivers – classifications – Meandering and cut-off – River training works - Objectives – Classification and Types of river training works.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*Santosh Kumar Garg,**"Irrigation Engineering and Hydraulics Structures"**, Khanna Publications Pvt. Ltd. New Delhi, 2023.*
2	*Punmia.B.C. and Pande B.B.Lal,**"Irrigation and Water Power Engineering"**, Laxmi Publications Pvt. Ltd, New Delhi, 2021.*

REFERENCES :

1	*Sharma. R.K. and Sharma.T.K, **"Irrigation Engineering and Hydraulics Structures"**, S.Chand & Company Pvt. Ltd, NewDelhi, 2017.*
2	*P.N.Modi, **"Irrigation water resources and Water Power engineering"**,Standard book House, New Delhi, 2020.*
3	*Madan Mohan Das and Mimi Das Saikia, **" Irrigation and water power Engineering"**,PHI Learning Ltd, Delhi, 2014.*
4	*Asawa G.L.,**"IrrigationandWaterResourcesEngineering"**,New Age International Publications, New Delhi, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Discuss the necessity and methods of irrigation system	K2
CO2	Design the diversion headworks in water distribution system	K3
CO3	Practice the design principles and importance of arch dam, buttress dam and earth dams.	K2
CO4	Select the appropriate type of canal regulation structures in different situations.	K2
CO5	Identify the remedy for water logging, importance of drainage and river control works.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	1	1	-	-	-	-	-	-	-	1	2	2
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	2	2
CO3	3	2	-	1	1	-	-	-	-	-	-	-	1	2	2
CO4	3	2	-	1	1	-	-	-	-	-	-	-	1	2	2
CO5	2	1	-	1	-	-	-	-	-	-	-	-	1	2	2
22CPE$15	3	2	1	1	1	-	-	-	-	-	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.4.1, 4.1.4, 5.2.2, 5.3.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 4.1.4, 5.2.2,5.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1, 4.1.4, 5.2.2, 5.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1, 4.1.4, 5.2.2, 5.3.1
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3,2.3.2, 2.4.1, 4.1.4

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$16	HYDROLOGY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To obtain the knowledge on the spatial and temporal variations of rainfall and their analysis, design of well system and predict the future floods and identify their routing.	
UNIT – I	**HYDROMETEOROLOGY**	**9 Periods**
Hydrological cycle – processes and budget - Hydro meteorological factors – Cloud formation – Winds and their movement –Types of precipitation– Forms of precipitation – Indian monsoon system– Density and Adequacy of rain gauges– Recording and non- recording raingauges–Optimum number of raingauges.		
UNIT – II	**PRECIPITATION AND ABSTRACTIONS**	**9 Periods**
Spatial distribution – Consistency analysis – Frequency analysis – Intensity, duration, frequency relationships – Evaporation– Infiltration – Horton's equation – Infiltration indices – measurement of infiltration–abstraction loss.		
UNIT – III	**STREAM FLOW**	**9 Periods**
Runoff process –measurement of stream flow– factors affecting stream flow– Stage-discharge relationship– Peak discharge estimation– hydrograph analysis– base flow separation– unit hydrograph for stream flow estimation– synthetic unit hydrograph– hydrological modeling.		
UNIT – IV	**GROUND WATER HYDROLOGY**	**9 Periods**
Occurrence of ground water – Types of aquifer – Dupuit's assumptions – Darcy's law – Estimation of aquifer parameters – Pump tests – Steady and unsteady state conditions - Discharge in a Confined and Unconfined Aquifers–Leaky aquifer–well loss–aquifer loss–problems.		
UNIT – V	**FLOOD ANALYSIS**	**9 Periods**
Flood estimation – Gumbel's method – Log Pearson type III method – Reservoir flood routing – Channel routing – Types of streams – Stage discharge relationships - Flow measurements – Current meter method for velocity measurements.		
Contact Periods: **Lecture:45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*SantoshKumarGarg,* ***"Irrigation Engineering and Hydraulics Structures"****, Khanna Publishers, NewDelhi, 2023.*
2	*Jayaramy Reddy. P.,* ***"Hydrology"****,Tata McGraw-Hill Publications Pvt. Ltd, NewDelhi, 2016*

REFERENCES:

1	*Subramanya. K.,* ***"Engineering Hydrology"****, Tata McGraw-Hill Publications Pvt. Ltd, NewDelhi,2017*
2	*Warren Viessman and Gary L. Lewis,* ***"Introduction to Hydrology"****, Prentice Hall of India Pvt.Ltd,NewDelhi,2003*
3	*David K. Todd and Larry W. Mays,* ***"Groundwater Hydrology"****, Wiley Publications Pvt. Ltd,NewDelhi,2011*
4	*Asawa G.L.,* ***"Irrigation and Water Resources Engineering"****, New Age International Publications, NewDelhi, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Summarise the types of rain gauges and estimate optimum number of raingauges	K2
CO2	Present the meteorological data for forecasting analysis.	K2
CO3	Identify the needs and importance of hydrographs in Run-off studies	K2
CO4	Design the open and tube wells for different aquifers	K2
CO5	Predict the future floods and identify the importance of flood routing	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	1	1
CO2	3	1	1	1	1	-	-	-	-	-	-	-	2	1	1
CO3	3	2	1	1	1	-	-	-	-	-	-	-	2	1	1
CO4	3	2	1	1	1	-	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	-	-	-	-	-	-	-	2	1	1
22CPE$16	3	2	1	1	1	-	-	-	-	-	-	-	2	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 4.1.4, 5.2.2, 5.3.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 4.1.4, 5.2.2,5.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 4.1.4, 5.2.2, 5.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.2, 2.4.1,3.2.1, 4.1.4, 5.2.2, 5.3.1
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3,2.3.2, 2.4.1, 3.1.1, 3.2.1, 4.1.4, 5.2.2,5.3.1

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$17	ENVIRONMENTAL MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.	
UNIT – I	**NATURE AND SCOPEOF ENVIRONMENTAL PROBLEMS**	**9 Periods**
Environment and sustainable development – Natural and human environmental disturbances – Global warming –acid rain – ozone depletion – effects and control - climate change conventions – Kyoto protocol– India's efforts for Environmental protection– Public policy and role of NGO's		
UNIT – II	**WATER POLLUTION AND CONTROL**	**9 Periods**
Fresh water and its pollution – Natural processes – sources and pollutants – pollution due to industrial, agricultural and municipal wastes – effects on streams - limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management Water management – Marine environment and its management– Water acts		
UNIT – III	**AIR AND NOISE POLLUTION**	**9 Periods**
Pollutant emissions - sources and sink – effects of air pollution on human health, vegetation and climate– Global effects – prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution –Sound level–Effect of noise on people–Environmental noise control-noise pollution rules		
UNIT – IV	**SOLID WASTE MANAGEMENT AND SOIL POLLUTION**	**9 Periods**
Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques– OnsiteHandling,storageandprocessing–sanitarylandfill–Incineration and pyrolysis –Composting–aerobic and anaerobic of compositing – Recycling and reuse of solid wastes – Hazardous wastes –Definition – Sources& types only – The Basel conventional use and degradation –strategies for sustainable and management– soil pollution – wetland conservation		
UNIT – V	**ENVIRONMENTALMANAGEMENTSYSTEM**	**9 Periods**
Terminology – installation and common motives of EMS – Environmental standards – ISO 14000(Series) – basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection–Practices for Waste Minimization and Cleaner Production.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

TEXT BOOKS:

1	*Rao, **"Air Pollution"**, Tata McGraw-Hill Education, 1 July, 2017*
2	*N.K.Uberoi, **"Environmental Management"**, Excel Books, New Delhi, 2011.*

REFERENCES:

1	*S.Vigneshwaran, M.Sundaravadivel and D.S.Chaudhary, "**Environmental Management",** SCITECH Publications(India) Pvt.Ltd, Chennai & Hyderabad ,2010.*
2	*Technobanoglous, "**Environmental management**", Mc Graw Hill Book Company ,2006.*
3	*Howard S. Peavy, Donald R. Rowe and GerogeTchobanoglous, "**Environmental Engineering**", McGraw - Hill Co., 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the common issues related with environment.	K2
CO2	Analyse the sources, causes and effects of water pollution and their control.	K2
CO3	Infer the air pollution and noise pollution.	K2
CO4	Implement the various management techniques of solid waste and soil pollution.	K2
CO5	Compare the status of Environmental Management Systems.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	-	-	2	-	-	-	-		1	3	-
CO2	1	2	-	-	1	-	3	-	-	-	-	1	3	3	1
CO3	1	2	-	-	1	-	3	-	-	-	-	1	3	3	1
CO4	1	2	-	-	1	-	3	-	-	-	-	1	3	3	1
CO5	2	1	-	-		-	2	-	-	-	-		1	3	1
22CPE$17	1	2	-	-	1	-	3	-	-	-	-	1	3	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2.2.4,2.4.3,4.1.1,4.1.2,6.1.2
CO2	3.1.1,3.1.2,3.2.1,3.4.2,4.1.1,4.1.2,4.3.1,6.1.1,7.1.2
CO3	4.1.1,4.1.2,4.2.1,4.3.4,5.1.2,5.2.1,5.3.2,6.1.1,7.1.2,7.2.2,12.2.2
CO4	1.2.1,1.3.1,2.1.2,2.2.3,3.2.1,3.2.3,2.1,3.2.3,4.1.1,4.1.2,4.1.3,4.2.1,5.3.2,6.1.1,7.1.2,7.2.2
CO5	3.1.2,3.1.5,3.3.2,4.1.1,4.2.1,4.3.4,5.2.3,6.1.1,7.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$18	AIR POLLUTION MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Aimed at imparting knowledge of sources and effects of air pollution and to understand the control measure adopted for removal of air pollutant.	
UNIT – I	**FUNDAMENTAL OF AIR POLLUTION**	**9 Periods**
Atmosphere as a place of disposal of pollutants – Definition- Air Pollution – AirPollutants – Source and classification of pollutants – Units of measurements of pollutants -Ambient air quality standards - Air pollution indices - Air pollution and its effects onhuman beings, plants and animals - Economic effects of air pollution – Air Pollution Episodes.		
UNIT – II	**METEOROLOGY AND SAMPLING OF AIR POLLUTION**	**9 Periods**
Meteorology - temperature lapse rate– Adiabatic lapse rate – WindRose - Inversion – Wind velocity and turbulence –Atmospheric stability and mixing heights, Plume behavior – Windrose. Ambient air sampling and measurement of particulate and gaseous pollutants Environmental factors - Stack sampling - Plume behaviour - Dispersion of air pollutants - Maximum mixing depth - Estimation of plume rise - Stack design.		
UNIT – III	**CONTROL OF PARTICULATE CONTAMINANTS**	**9 Periods**
Factors affecting Selection of Control Equipment – Working Principle of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.		
UNIT – IV	**CONTROL OF GASEOUS CONTAMINANTS**	**9 Periods**
Factors affecting Selection of Control Equipment – Working principle of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters - Operational Considerations		
UNIT – V	**INDOOR AIR QUALITY**	**9 Periods**
Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness Sources and Effects of indoor air Pollution – Measurement – Standards –Control and Preventive measures.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45Periods**		

TEXTBOOKS:

1	*Noel de Nevers, **"Air Pollution Control Engineering",** Waveland press,Inc 2017.*
2	*Dr. Y. Anjaneyulu, **"Air Pollution: Prevention and Control Technologies",** BS publications (P) Ltd., 2nd edition,2020.*

REFERENCES:

1	*Noel de Nevers, "**Air Pollution Control Engg**", McGraw Hill, New York, 2016.*
2	*Air Pollution, Climate Change, and Human Health in Indian Cities: A Brief Review, August 2021*
3	*Howard S. Peavy, Donald R. Rowe and GerogeTchobanoglous, "**Environmental Engineering**", McGraw - Hill Co., 2013.*
4	*M.N Rao and HVN Rao, **"Air Pollution**",TataMcgraw Hill Publishing Company limited,2007.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Extract the status of global and analysis of air pollutant scenario and their effects.	K2
CO2	Classify the meteorological condition to prevail for the dispersion air pollution.	K2
CO3	Implement the concepts of control strategies adopted for removal of Particulate pollutants.	K2
CO4	Implement the concepts of control strategies adopted for removal of gaseous pollutants.	K2
CO5	Identify the causes of indoor air pollution and their effects.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	2	1	1	1	-	2	-	-	-	-	-	-	-	-	-
CO2	2	2	1	2	-	2	1	-	-	-	-	-	-	-	-
CO3	2	1	1	2	-	2	2	-	-	-	-	-	1	1	1
CO4	2	1	1	2	-	2	2	-	-	-	-	-	1	1	-
CO5	1	1	1	2	-	2	1	-	-	-	-	-	2	2	1
22CPE$18	2	1	1	2	-	2	2	-	-	-	-	-	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.4,2.4.3,3.1.5,4.1.1,4.1.2,6.1.1
CO2	2.1.3,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.6,4.1.1,4.1.2,4.1.4,6.1.1,7.1.2,
CO3	1.2.1,1.3.1,2.1.2,2.2.3,2.2.4,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO4	1.2.1,1.3.1,2.1.2,2.2.3,2.4.3,3.2.1,3.2.3,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2,7.2.2
CO5	1.3.1,2.2.3,2.4.3,3.1.5,4.1.1,4.1.2,4.2.1,6.1.1,7.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$19	INTEGRATED URBAN WATER MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To get exposure to integrated water resources management (IWRM), sustainable water resources management, water security and public-private participation issues	
UNIT – I	**CONCEPTS, PRINCIPLES AND TOOLS**	**9 Periods**
Modern principles of water management and planning-Definition, components, and critique of IWRM-IWRM implementation: socio-scientific, economic, political and ecological factors affecting the implementation-Global and national perspectives of water crisis, water scarcity, water availability and requirements of human beings and nature- Concepts of 'blue water', 'green water' and 'grey water' and their role in water management-Global climate change and its effects on natural water resources.		
UNIT – II	**SUSTAINABLE WATER RESOURCES MANAGEMENT**	**9 Periods**
Concept of sustainable development-Sustainability principles for water management -Important preconditioning in water policy approaches-Framework for planning a sustainable water future-Integration of natural water resources in national water supply systems-Sustainable use of natural water resources in arid and semi-arid regions- Water balance: matching water sources with demands-Minimum water table and minimum discharges.		
UNIT – III	**RESOURCES AND END USERS**	**9 Periods**
Population-water resources equation-Water stress, strain and water modulus -Resource classification-Resource assessment (water quantity and quality)-Role of water in serving national interests: agriculture, nature, peace agreements, others -Strategic importance of agriculture and its role in the national water demand picture -Competition between water consumers on water resources-Role of "shadow water" (partly virtual water) in balancing population-Water resources equation		
UNIT – IV	**CONVENTIONAL AND NON-CONVENTIONAL TECHNIQUES FOR WATER SECURITY**	**9 Periods**
Rainwater harvesting-Groundwater mining and artificial recharge-Conjunctive use of surface water and groundwater resources-Long-distance water conveyance and transport- Inter-basin water transport-Conservation of 'green water'-Desalination-Treatment of poor quality watersHealth protection and promotion in the context of IWM- Health impact assessment of water resources development- Virtual water trade for achieving global water security.		
UNIT – V	**PUBLIC-PRIVATE PARTNERSHIP IN WATER MANAGEMENT**	**9 Periods**
Private sector involvement in water resources management: PPP objectives, PPP options, PPP processes, PPP experiences through case studies – Links between PPP and IWM-Private water markets		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods**		

TEXT BOOKS:

1	*S.S. Negi*, ***"Handbook of Soil Conservation and Integrated Watershed Development"***, *International Book distributors, 2009*
2	*Cech Thomas V.,****"Principles of Water Resources: History, Development, Management and Policy"***, *John Wiley and Sons Inc., New York, 2018.*

REFERENCES :

1	*Briscoe, J. and S., M.R.P. "**Handbook of Water Resources in India: Development, management, and Strategies**"*, Oxford University Press, New Delhi, 2007
2	*Rajesh Rajora, "**Integrated Watershed Management: Field Manual for Equitable, Productive and Sustainable Development**" Rawat Publications, 2019*
3	*Isobel W. Heathcote, "Integrated Watershed Management: Principles and Practice", John Wiley and Sons Inc., New York, 2009*
4	*Ajay Singh,**"Wastewater reuse and Watershed Managment"**, Apple Academic Press,2019.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Define the concepts, principles and tools of IWRM	K2
CO2	Formulate sustainable water management options	K2
CO3	Discuss the importance of water resources and carry out water resource assessment	K2
CO4	Apply the conventional and non-conventional techniques for water security.	K2
CO5	Analyse the importance of public-private partnership in water management.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2
CO2	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2
CO3	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2
CO4	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2
CO5	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2
22CPE$19	3	1	1	-	1	2	2	-	-	-	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2, 3.1.5, 3.1.6, 5.2.1,6.2.1,7.2.1,7.2.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.2.2, 2.3.2, 3.1.5, 3.1.6, 5.2.1,6.2.1,7.2.1,7.2.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.2.2, 2.3.2, 3.1.5, 3.1.6, 5.2.1,6.2.1,7.2.1,7.2.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.2.2, 2.3.2, 3.1.5, 3.1.6, 5.2.1,6.2.1,7.2.1,7.2.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.2.2, 2.3.2, 3.1.5, 3.1.6, 5.2.1,6.2.1,7.2.1,7.2.2

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$20	GROUND IMPROVEMENT TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To study different methods of improvement and to select the appropriate methods based on the soil type and ground conditions.	
UNIT – I	**DEWATERING**	**9 Periods**
Scope and necessity- Engineering properties of soft and compressible deposits – Classification of ground modification techniques -– Emerging trends in ground improvement-Selection based on soil conditions – Dewatering by well point system – Deep well-Vacuum and Electro - Osmotic method.- Heat treatment-ground freezing.		
UNIT – II	**COMPACTION AND VERTICAL DRAINS**	**9 Periods**
In-situ densification of granular soils and consolidation of cohesive soils – Shallow and deep compaction – Vibration methods – Vibrocompaction- Blasting- Vibroflotation – precompression and compaction piles –Heavy Tamping – Preloading -Vertical drains —Sand drains, Wick drains –Relative merits and limitations.		
UNIT – III	**STONE COLUMN AND CONSOLIDATION**	**9 Periods**
Stone columns - lime piles-micropiles – Construction methods – merits and demerits – Pre-compression and consolidation – simple design-Dynamic consolidation – Electro-osmotic consolidation –Soil reinforcement – Geosynthetics-types –Applications- filtration – drainage – separation – reinforcement – Soil Nailing-Rock bolting.		
UNIT – IV	**STABILIZATION AND CONFINEMENT**	**9 Periods**
Stabilization methods – Mechanical, Chemical stabilization-Cement, Lime, flyash and Bitumen – Electro - kinetic stabilization – Stabilization of expansive clays-Stabilization using Industrial wastes. Concept of confinement, Gabion walls, Crib walls and fabric form work.		
UNIT – V	**GROUTING**	**9 Periods**
Types of grouts – Suspension and solution grouts –Basic requirements – Displacement grouting – Compaction grouting – Permeation grouting –Cement grouting-Lime grouting - Grouting equipment and methods – Grout monitoring schemes.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Purushothama Raj, P., **"Ground Improvement Techniques",** Laxmi Publications (P) Ltd., New Delhi, 2005*
2	*Nihar Ranjan Patra., **"Ground Improvement Techniques",** Vikas publishing House Pvt. Ltd., 2012.*

REFERENCES:

1	*Day,R.W., **"Foundation Engineering Handbook"**, Mc-Graw Hill Companies, Inc. 2006.*
2	*Manfred R .Haussmann **"Engineering Principles of ground modification"**, Mc Graw Hill, 2013.*
3	*Peter G. Nicholson, **"Soil Improvement and Ground Modification Methods",** Butterworth Heinemann, 2015 .*
4	*Klaus Kirsch and Alan Bell, **"Ground Improvement,"** Third Edition, CRC Press, Taylor and Francis Group, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Select suitable ground improvement techniques and different dewatering techniques based on soil conditions.	K2
CO2	Assess various in-situ treatment of cohesionless and cohesive soils.	K2
CO3	Perform in the the field with the use of stone column and earth reinforcement.	K2
CO4	Identify and adopt suitable stabilization methods.	K2
CO5	Select and apply different grouting techniques.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	2	-	1	-	3	-	-	1	2	1		1	2
CO2	2	2	3	1	1	-	3	-	-	1	2	1	2	2	2
CO3	2	2	3	1	1	-	3	-	-	1	2	1	3	3	3
CO4	2	1	1	1	1	-	3	-	-	1	2	1	2	3	3
CO5	2	1	1	1	1	-	3	-	-	1	2	1	3	3	3
22CPE $20	2	2	3	1	1	-	3	-	-	1	2	1	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.4,3.1.1,3.1.5,3.2.3,3.3.2,3.4.1,3.4.2,5.3.1,7.1.1,7.1.2,7.2.2,10.1.1,10.2.1,11.2.1,11.3.1,12.2.2,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.4.1,2.4.3,2.4.4,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.2,4.1.4,5.2.1,5.3.1,7.1.1,7.1.2,7.2.2,10.1.1,10.2.1,11.2.1,11.3.1,12.2.2,12.3.2
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.2.4,2.4.1,2.4.3,2.4.4,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.2,3.4.1,3.4.2,4.2.2,4.1.4,5.3.1,7.1.1,7.1.2,7.2.2,10.1.1,10.2.1,11.2.1,11.3.1,12.2.2,12.3.2
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.2.4,3.1.3,3.1.5,4.1.4,5.3.1,7.1.1,7.1.2,7.2.2,10.1.1,10.2.1, 11.2.1,11.3.1,12.2.2,12.3.2
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.2.3,2.2.4,3.1.3,3.1.5,4.1.4,5.2.1,5.3.1,7.1.1,7.1.2,7.2.2,10.1.1, 10.2.1,11.2.1,11.3.1,12.2.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	60	-	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	60	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22CPE$21	SLOPE STABILITY AND LANDSLIDES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To impart knowledge on stability analysis of slopes, understand the problems associated with landslides, instrumentation employed for slope studies and different slope stabilization measures.	
UNIT – I	**STABILITY OF SLOPES**	**9 Periods**
Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.		
UNIT – II	**STABILITY ANALYSIS**	**9 Periods**
Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations		
UNIT – III	**IRREGULAR SLOPE**	**9 Periods**
Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.		
UNIT – IV	**LANDSLIDES AND SUBSIDENCE**	**9 Periods**
Engineering problems involving the stability of slopes – Cuts in sand – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses –Slopes on weathered rock. Mass movement classification-role of pore water pressure-characterization of pore water pressure in slopes-effect of antecedent rainfall-progressive failure.		
UNIT – V	**FIELD OBSERVATIONS AND SLOPE STABILIZATION**	**9 Periods**
Field instrumentation - Observation studies during Construction – Post construction, piezometers – Settlement plates – Inclinometer – Compaction of natural masses of soil and existing fills – Drainage as a means of stabilization – Use of geotextiles – Soil nailing.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Y.M.Cheng and C.K.Lau., **"Slope Stability Analysis and Stabilization",** CRC Press Inc; 2014.*
2	*Robin Chowdhury.,**" Geotechnical Slope Analysis(1st edition)"** , CRC Press; 2009.*

REFERENCES:

1	*J.M.Duncan, S.G. Wright and T.L.Brandon., **"Soil Strength and Slope Stability",** (2nd edition) Wiley; 2014.*
2	*K.R.Arora., **Soil Mechanics and Foundation Engineering** (2nd edition), Standard Publisher Distributor, 2020.*
3	*R,Chowdhury, P. Flentje and G.Bhattacharya., **"Geotechnical Slope Analysis",** CRC Press Inc; 2019.*
4	*Lynn M.Highland and Peter Bobrowsky., **"The Landslide Handbook-A Guide to Understanding Landslides",** U.S.Geological Survey, Reston, Virginia 2008.*

COURSE OUTCOMES: At the end of the course, students will be able to		Bloom's Taxonomy Mapped
CO1	Identify the types of slope failure and the computation of stability.	K2
CO2	Analyse stability of slopes in cohesive and cohesionless soils.	K2
CO3	Analyse irregular slopes with different approaches.	K2
CO4	Examine the causes of landslides and soil subsidence.	K2
CO5	Select and use instruments in the slope stability and execute suitable slope stability measures.	K2

COURSE ARTICULATION MATRIX :

COs/ POs	PO 1	PO 2	P O3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	1	1	2	-	-	3	1	-	1	2	1	-	3	1
CO2	3	3	1	3	2	2	3	-	-	2	3	1	-	3	2
CO3	3	3	1	3	2	2	3	-	-	2	3	1	-	3	2
CO4	3	2	1	2	2	2	3	-	1	2	3	1	-	2	3
CO5	3	2	2	2	2	2	3	-	1	2	3	1	3	3	3
22CP E$21	3	3	2	3	2	2	3	1	1	2	3	1	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.1,2.2.2,3.1.1,3.1.2,3.1.5,4.1.1,4.3.1,4.3.3,4.3.4,7.1.1,7.1.2,7.2.1,7.2.2,8.2.2,10.3.1,11.1.2,11.2.1,11.3.1,12.1.2
CO2	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.2,3.1.3,3.1.5,4.1.1,4.1.2,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.2,5.2.1,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,10.1.2,10.3.1,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO3	1.1.1,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.2,3.1.3,3.1.5,4.1.1,4.1.2,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.2,5.2.1,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,10.1.2,10.3.1,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO4	1.1.1,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.1,2.4.2,3.1.2,3.1.3,3.1.5,4.1.1,4.3.1,4.3.2,4.3.4,5.1.2,5.2.1,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,9.1.2,10.1.1,10.1.2,10.3.1,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO5	1.1.1,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.1,3.1.2,3.1.3,3.1.5,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.3,4.3.1,4.3.2,4.3.4,5.1.2,5.2.1,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,9.1.2,10.1.1,10.1.2, 10.3.1,11.3.1,11.3.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	60	-	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	60	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22CPE$22	EARTH RETAINING STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To impart knowledge on earth pressure theories, design of retaining walls, sheet pile walls, concepts of braced excavation and understands the concepts and mechanisms of reinforced earth retaining wall.	
UNIT – I	**EARTH PRESSURE THEORIES**	**9 Periods**
Introduction – State of stress in retained soil mass – Classical earth pressure theories – Active and Passive earth pressures – Earth pressure at rest – Earth pressure due to external loads – Empirical methods–Wall movements and complex geometry–Graphical method of computing earth pressure–Rehbann's and Culmann's approach.		
UNIT – II	**RETAINING WALLS**	**9 Periods**
Retaining walls – Uses and types – Forces on retaining walls – Design of retaining walls by limit state method – General principles – Design and construction details – Design of solid gravity walls, Semi –gravity walls, cantilever walls, counterfort walls – Stability of retaining walls–Drainage arrangements and its influence.		
UNIT – III	**SHEET PILE WALLS**	**9 Periods**
Earth retaining structures–Selection of soil parameters–Analysis and design of cantilever and anchored sheet pile walls–Deadman and continuous anchor–Diaphragm and bored pile walls–Design requirements.		
UNIT – IV	**BRACED EXCAVATION**	**9 Periods**
Braced cuts in sand and clay–Lateral pressure on sheeting in Braced excavation–Stability against Piping and bottom heaving–Procedure for computation of lateral earth pressure for braced cut sand Flexible Bulkheads–Soil anchors–Soil nailing–Soil pinning–Methods of design.		
UNIT – V	**REINFORCED EARTH RETAINING WALL**	**9 Periods**
Reinforced earth retaining wall–General principles, Concepts and Mechanism of reinforced earth–Design consideration of reinforced earth–Geotextile, geogrids, and metal strip sand facing elements–Construction–Selection of type of retaining structures–Construction practice–Field observations.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Winterkorn H.F. and Fang H.Y., "**Foundation Engineering Handbook"**, Galgotia Book source, 2000.*
2	*McCarthy D.F., "**Essentials of soil Mechanics and foundations",** Basic Geotechnics (sixth Edition) Prentice Hall, 2002.*

REFERENCES:

1	*Rowe R.K., "**Geotechnical and Geo environmental Engineering Hand Book",** Kluwer Academic Publishers, 2001.*
2	*Gopal Ranjan and ASR Rao, **"Basic & Applied soil mechanics"** New Age International Publishers, 2011.*
3	*Clayton C.R.I. Militisky, Jand Woods R., "**Earth pressure and earth retaining structures (second Edition)**", Survey University Press, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Estimate earth pressure theories and computation of earth pressure	K2
CO2	Calculate the forces on retaining walls and design the retaining walls	K2
CO3	Carryout analysis and design of sheet pile walls	K3
CO4	Design braced excavations, soil nailing, pinning, and anchoring on stability considerations.	K3
CO5	Apply concepts of reinforcement in earth retaining structures.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	3	1	1	-	2	-	-	1	1	-	-	1	1	1
CO2	3	3	2	2	-	2	-	-	1	1	-	-	1	2	2
CO3	3	2	2	2	-	2	-	-	1	1	-	-	1	2	2
CO4	3	3	1	2	-	2	-	-	1	1	-	-	1	2	2
CO5	2	2	1	1	-	2	-	-	1	1	-	-	1	2	2
22CPE$22	3	3	2	2	-	2	-	-	1	1	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2, 6.2.1,9.3.1, 10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	20	40	40	-	-	-	100

22CPE$23	FOUNDATION IN EXPANSIVE SOILS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To study the properties, the controlling techniques of swelling and to select suitable foundations in expansive soils.	
UNIT – I	**GENERAL PRINCIPLES**	**9 Periods**
Origin of expansive soils–Physical properties of expansive soils–Mineralogical composition Identification of expansive soils–simple laboratory tests – Classification of expansive soils – Field conditions that favour swelling–Consequences of swelling.		
UNIT – II	**SWELLING CHARACTERISTICS**	**9 Periods**
Swelling Mechanism, Swelling measurements–factors affecting – Laboratory methods–Prediction of Swelling characteristics–Evaluation of heave.		
UNIT – III	**TECHNIQUES FOR CONTROLLING SWELLING**	**9 Periods**
Horizontal moisture barriers–Vertical moisture barriers–Surface and subsurface drainage–Pre-wetting – Soil replacement–Sand cushion techniques–CNS layer technique.		
UNIT – IV	**FOUNDATIONS ON EXPANSIVE SOILS**	**9 Periods**
Belled piers–Bearing capacity and skin friction–Advantages and disadvantages–Design of belled Piers–Under-reamed piles–Design and construction.		
UNIT – V	**MODIFICATION OF SWELLING CHARACTERISTICS**	**9 Periods**
Lime stabilization–Mechanisms–Limitations–Lime injection–Lime columns– Mixing– Chemical stabilization – Construction.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Fu Hua Chen,* ***"Foundations on Expansive Soils"****, Elsevier Scientific Publishing Company, New York, 2012.*
2	*Gopal Ranjan and A.S.R Rao,* ***"Basic and Applied Soil Mechanics"****, New Age International Publishers–New Delhi, 2018.*

REFERENCES:

1	*Hand Book on,* ***"Under reamed and Bored Compaction Pile Foundation"****, CBRI, Roorkee. 2001.*
2	*IS: 2720 (Part XLI)–1977–Measurement of Swelling Pressure of Soils.*
3	*R.K.Katti, D.R K Atti, A.R .Katti,* ***"Behaviour of Saturated Expansive Soil & Control Methods",*** *CRC Press, 2002.*
4	*Alam Singh, "***Modern Geotechnical Engineering",*** *Geo-Environ Academia, Jodhapur. 3rd Edition, 2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Assess the occurrence and distribution of expansive soils.	K2
CO2	Estimate the properties of expansive soils and identify the controlling techniques.	K2
CO3	Identify the various methods of stabilization of expansive soils.	K3
CO4	Design different types of foundations on expansive soil.	K3
CO5	Apply suitable techniques and learn the mechanism of treatment of swelling soils.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	2	2	-	-	-	-	-	2	2	2
CO2	2	1	1	1	1	2	2	-	-	-	-	-	2	1	2
CO3	2	1	1	1	1	2	2	-	-	-	-	-	2	1	2
CO4	2	1	1	1	1	2	2	-	-	-	-	-	2	1	2
CO5	2	2	1	1	1	2	2	-	-	-	-	-	2	1	2
22CPE$23	2	2	1	1	1	2	2	-	-	-	-	-	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2,5.3.1, 6.2.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2,5.3.1, 6.2.1,7.1.2,7.2.2
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 5.3.1,6.2.1,7.1.2,7.2.2
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2,5.3.1, 6.2.1, 7.1.2,7.2.2
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2,5.3.1, 6.2.1, 7.1.2,7.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$24	LAND RECLAMATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To get an idea of characteristic of waste, processes and remediation techniques and to impart knowledge on the needs, techniques, classification, design and operation of landfills.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Soil around us, Soil Water Characteristics, Soil Erosion, Soil and Pollution, Water resources, Irrigation And Wetlands, Soil Pollution Management, Nuclear Waste Management, Solid Waste Management.		
UNIT – II	**TRANSPORTATION OF WASTES**	**9 Periods**
Handling and segregation of wastes at source-storage and collection of municipal solid wastes-Analysis of collection systems- Need for transfer and transport- Transfer stations Optimizing Waste allocation-compactability, storage, labeling and handling of hazardous wastes-hazardous waste manifest sand transport.		
UNIT – III	**TREATMENT OF WASTES**	**9 Periods**
Objectives of waste processing-material separation and processing technologies-biological and chemical conversion technologies-method and controls of composting-thermal conversion technologies and energy recovery-incineration-solidification and stabilization of hazardous wastes-treatment of Biomedical wastes.		
UNIT – IV	**LANDFILLS**	**9 Periods**
Waste disposal options- Disposal in landfills- Landfill Classification, types and methods- site selection-design and operation of sanitary landfills, secure landfills and landfill bioreactors-leachate and landfill gas management-landfill closure and environmental monitoring-closure of landfills-landfill remediation.		
UNIT – V	**WASTE MANAGEMENT AND BIOREMEDIATION**	**9 Periods**
Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management-Elements of integrated waste management and roles of stakeholders-Salient features of Indian legislations on management and handling of municipal solid wastes ,hazardous wastes, biomedical Wastes-Bioremediation-techniques-field applications.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "**Integrated Solid Waste Management**, McGraw-Hill International edition, New York, 2010.*
2	*VesilindP.A., WorrellWandReinhart, "**Solid Waste Engineering"**, Thomson Learning Inc., Singapore, 2002.*

REFERENCES:

1	*Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. Evans "**Environmental Resources Management, Hazardous waste Management"**, McGraw-Hill International edition, New york, 2001.*
2	*CPHEEO "**Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization**, Government of India, New Delhi, 2000.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret the fundamentals of solid and hazardous wastes and also the types, need and sources of solid and hazardous wastes.	K2
CO2	Examine the methods of waste characterization, source reduction and the generation of wastes.	K1
CO3	Demonstrate the storage, collection handling, segregation and transportation of wastes.	K2
CO4	Apply the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes	K3
CO5	Apply the advancement of various waste disposal methods.	K3

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COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	-	1	2	-	-	-	-	-	1	2	2
CO2	2	2	1	2	-	1	2	-	-	-	-	-	2	2	2
CO3	2	1	2	2	-	1	2	-	-	-	-	-	2	2	2
CO4	1	2	2	2	-	1	2	-	-	-	-	-	2	2	2
CO5	1	1	1	3	-	1	2	-	-	-	-	-	2	2	2
22CPE$24	2	2	2	2	-	1	2	-	-	-	-	-	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2,6.1.1,7.1.1,7.1.2,7.2.2
CO2	1.2.1, 1.3.1,1.4.1, 2.1.3,2.2.3, 2.3.1, 2.4.3,3.1.4, 3.1.6,3.3.1, 4.1.1, 4.1.2, 6.1.1, 7.1.1,7.1.2,7.2.2
CO3	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3,, 3.1.4, 3.1.6,3.3.1,3.2.3, 4.1.1, 4.1.2,6.1.1, 7.1.1,7.1.2,7.2.2
CO4	1.2.1, 1.3.1,1.4.1, 2.1.3,2.2.3, 2.3.1, 2.4.3, 3.1.4, 3.1.6, 3.2.3,3.3.1, 4.1.1, 4.1.2, 6.1.1, 7.1.1,7.1.2,7.2.2
CO5	1.2.1, 1.3.1,1.4.1, 2.1.3,2.4.3, 3.1.4, 3.1.6,3.3.1, 4.1.1, 4.1.2, 6.1.1, 7.2.2, 7.1.1,7.1.2,7.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$25	ENVIRONMENTAL GEOTECHNOLOGY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire knowledge on the geotechnical engineering problems associated with contaminated soil, transport of contaminants and to select suitable remediation technologies.	
UNIT – I	**SUBSURFACE CONTAMINATION AND INTERACTION**	**9 Periods**
Sources, production, classification and composition of waste – Causes of soil pollution – Classification, identification and characterization of contaminated soils –Environmental laws, regulations and Assessment- In-situ large direct shear test for MSW, Factors governing soil – Pollutant interaction– Failures of foundations due to pollutants		
UNIT – II	**SITE SELECTION AND SAFE DISPOSAL OF WASTE**	**9 Periods**
Safe disposal of waste – Site selection for landfills – Characterization of landfill sites – Risk assessment – Stability of landfills – cover system for hazardous and non-hazardous landfills-Current practice of waste disposal – Monitoring facilities – Passive containment system– Leachate contamination – Application of geosynthetics in solid waste management– Rigid and flexible liners.		
UNIT – III	**TRANSPORT OF CONTAMINANTS**	**9 Periods**
Contaminant transport in subsurface – Advection – Diffusion – Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Ground water pollution – Foundation for waste fill ground – Pollution of aquifers by mixing of liquid waste – Protection of aquifers		
UNIT – IV	**WASTE STABILIZATION**	**9 Periods**
Hazardous waste control and storage system – 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.		
UNIT – V	**REMEDIATION OF CONTAMINATED SOILS**	**9 Periods**
Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio-remediation, incineration, soil washing, electro-kinetics, soil heating, Vitrification, bio-venting – Ground water remediation – Pump and treat ,air sparging, reactive-well.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Yue Rong, “**Fundamentals of Environmental Site Assessment and Remediation”,** CRC Press, 2018.*
2	*Asante-Duah, “**Management of Contaminated Site Problems”,** Taylor and Francis Ltd, 2019.*

REFERENCES:

1	*Jo Strange and Nick Langdon, “**Contaminated Land: Investigation, Assessment and Remediation – Design and Practice Guides,”** ICE, 2008.*
2	*Maria C. Hernandez Soriano, “**Environmental Risk Assessment of Soil Contamination”**, Intech Open, 2014.*
3.	*Koerner, R.M., **“Design with Geosynthetics”**, Xlibris Corporation, USA, 2012.*
4.	*Fang H.Y and Ronald C. Chaney, **“Introduction to Environmental Geotechnology”,** Second Edition, CRC Press, 2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Identify sources of waste, contaminated soil and to assess the soil pollutant interaction.	K2
CO2	Select suitable sites for safe disposal of wastes	K2
CO3	Investigate different mechanisms of transport of contaminants	K2
CO4	Adopt appropriate waste stabilization techniques	K2
CO5	Recommend appropriate methods to remediate contaminated soils using different methods	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	1	2	3	-	-	-	3	1	-	2	1
CO2	2	1	1	1	1	2	3	-	-	-	3	1	3	3	2
CO3	3	3	1	1	-	-		-	-	-	1	-	-	1	1
CO4	2	1	1	1	1	2	3	-	-	-	3	1	3	3	3
CO5	2	1	1	1	1	2	3	-	-	-	3	1	3	3	3
23CPE $25	3	3	1	1	1	2	3	-	-	-	3	1	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.2,2.2.4,3.1.3,3.1.5,3.3.2,4.1.1,4.2.1,4.3.1,5.3.1,6.2.1,7.1.1,7.1.2, 7.2.2,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.2,2.2.4,3.1.3,3.1.5,3.3.2,4.1.1,4.2.1,5.1.2,5.3.1,6.1.1,7.1.1,7.1.2, 7.2.2,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO3	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.4.1,2.4.2,2.4.3,2.4.4,3.1.3,3.1.5, 3.3.2,4.1.1,4.2.1,4.3.1,11.3.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.2,2.2.4,3.1.3,3.1.5,3.3.2,4.1.1,4.2.1,4.3.1,5.1.2,5.3.1,6.1.1,7.1.1, 7.1.2,7.2.2,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.2,2.2.4,3.1.3,3.1.5,3.3.2,4.1.1,4.2.1,4.3.1,5.1.2,5.3.1,6.1.1,7.1.1, 7.1.2,7.2.2,11.1.1,11.1.2,11.2.1,11.3.1,12.2.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60		-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1 / Project1	40	60	-	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2 / Project 2	40	60	-	-	-	-	100
ESE	40	60					100

22CPE$26	REINFORCED SOIL STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To impart knowledge on Geosynthetic, design principles, materials and mechanism of reinforced soil, soil nailing and its applications in dams, embankments, pavements and foundation structures.	
UNIT – I	**PRINCIPLES AND MECHANISMS**	**9 Periods**
Historical background–Initial and recent developments–Principles, Concepts and mechanisms of reinforced soil–Factors affecting behavior and performance of soil–Reinforcement interactions.		
UNIT – II	**MATERIALS AND MATERIAL PROPERTIES**	**9 Periods**
Materials used in reinforced soil structures–Fill materials, reinforcing materials, metal strips, Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles – Bamboo – Timber – Facing elements – Properties – Methods of testing – Advantages and disadvantages–Preservation methods.		
UNIT – III	**DESIGN PRINCIPLES AND APPLICATIONS**	**9 Periods**
Design aspects of reinforced soil – Soil reinforcement function – Separator, Filtration, Drainage, Barrier function – Design and applications of reinforced soil of various structures – Retaining walls –Foundations–Embankment sand slopes.		
UNIT – IV	**GEOSYNTHETICS AND APPLICATIONS**	**9 Periods**
Introduction – Historical background – Applications – Design criteria – Geo synthetics in roads – Design – Giroud and Noiray approach – Geo synthetics in landfills – Geosynthetic clay liner – Design of landfills–Barrier walls.		
UNIT – V	**SOIL NAILING AND CASE HISTORIES**	**9 Periods**
Soil nailing – Introduction – Overview – Soil-Nail interaction – Behaviour – Design procedure – Behaviour in seismic conditions. Performance studies of reinforced dams, embankments, Pavements, Railroads, Foundations–Case studies.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*Sivakumar Babu, G.L.* ***"An introduction to Soil reinforcement and geosynthetics".*** *United Press (India) Pvt. Ltd, 2006.*
2	*Swami Saran, "****Reinforced Soil and its Engineering Applications****", I. K. International Pvt. Ltd, New Delhi, 2006.*

REFERENCES:

1	*Rao, G.V.* ***"Geosynthetics – An Introduction".*** *Sai Master Geoenvironmental Services Pvt. Ltd., Hyderabad, 2007.*
2	*Sarsby R W- Editor,* ***"Geo synthetics in Civil Engineering",*** *Wood head Publishing Ltd & CRC Press, 2007.*
3	*Koerner, R.M.* ***"Designing with Geosynthetics".*** *Vols. 1&2, 6th Edition, Xlibris Corporation, USA, 2012.*
4	*Shukla, S.K.* ***"Handbook of Geosynthetic Engineering"****, 2nd Edition, ICE Publishing, London, U.K, 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret the soil-reinforcement interaction mechanism.	K2
CO2	Examine the properties, testing methods of Geosynthetics in Earth reinforcement.	K1
CO3	Identify the soil reinforcement functions and the ability to select suitable reinforcing material to suit the functional requirement	K3
CO4	Analyze and design criteria for use of geo synthetics in landfills, pavement, liners	K3
CO5	Design various soil reinforcements, soil nailing major projects.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	2	-	-	1	1	-	-	1	1	1
CO2	2	2	1	1	-	2	-	-	1	1	-	-	1	2	2
CO3	2	2	1	1	-	2	-	-	1	1	-	-	1	2	2
CO4	3	2	1	1	-	2	-	-	1	1	-	-	1	2	2
CO5	3	2	1	1	-	2	-	-	1	1	-	-	1	2	2
22CPE$26	2	2	1	1	-	2	-	-	1	1	-	-	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.4.1, 2.1.3, 3.1.4, 3.2.3, 4.1.1, 4.1.2, 6.2.1, 9.3.1,10.1.1, 10.3.1
CO2	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO3	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO4	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1
CO5	1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.4.4, 3.1.4, 3.2.3, 3.4.2, 4.1.2, 6.2.1, 9.3.1, 10.1.1, 10.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	60	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	60	40	-	-	--	100
ESE	40	40	20	-	-	-	100

22CPE$27	DESIGN OF UNDERGROUND EXCAVATIONS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To get exposure to planning, analysis and design of underground support system and to learn about the various field tests conducted during and after construction of underground structures	
UNIT – I	**PLANNING AND EXPLORATION**	**9 Periods**
Introduction – planning and exploration of various underground construction projects – stereographic Projection method – principle and its application in underground excavation design		
UNIT – II	**ANALYSIS AND DESIGN OF UNDERGROUND STRUCTURES**	**9 Periods**
Elastic stress distribution around tunnels – stress distribution for different shapes and under different in-situ stress conditions – Green span method – design principles – multiple openings –openings in laminated rocks – elasto-plastic analysis of tunnels – Daemen's theory.		
UNIT – III	**TUNNELING METHODS**	**9 Periods**
Application of rock mass classification systems-ground conditions in tunneling-analysis of underground openings in squeezing and swelling ground – empirical methods – estimation of elastic modulus and modulus of deformation of rocks – uniaxial jacking / plate jacking tests – radial jacking and Goodman jacking tests – long term behavior of tunnels and caverns – New Austrian Tunneling Method (NATM) – Norwegian Tunneling Method (NTM) – construction de-watering.		
UNIT – IV	**ROCK MASS**	**9 Periods**
Rock mass – tunnel support interaction analysis – ground response and support reaction curves – Ladanyi's elasto– plastic analysis of tunnels – design of various support systems including concrete and shot-crete linings– steel sets-rock bolting and rock anchoring – combined support systems– estimation of load carrying capacity of rock bolts		
UNIT – V	**INSTRUMENTATION**	**9 Periods**
In-situ stress, flat jack- hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge- single and multi-point bore hole extensometers- load cells, pressure cells-Instrumentation and monitoring of underground excavations during and after construction-various case studies.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total:45 Periods**		

TEXT BOOKS:

1	*Hoek E. and Brown E.T.,"**Underground Excavations in Rocks", Institute of Mining Engineering",** 1981*
2	*Obert,L and Duvall,W.I.,"**Rock Mechanics and Design of Structures in Rocks"**,John Wiley,1967.*

REFERENCES:

1	*Singh B. and Goel R.K., **"Rock Mass Classification – APractical Engineering Approach",** Elsevier,1999.*
2	*Singh, B and Goel, R.K.,"**Tunneling in Weak Rocks**",Elsevier,2006.*
3	*Hoek,E, Kaiser P.K. and Bawden W.F.,"Support of **Underground Excavations in Hard Rock",**CRC Press,2000*
4	*Z.D.Cui, "**Design of underground structures**"*, Singapore: China Architecture & Building Press, 2020

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Discuss the use of elastic and plastic analysis in the design of underground support system.	K2
CO2	explain about the field tests generally conducted during and after construction of underground structures	K2
CO3	Critically analyse the behavior of underground structures.	K2
CO4	Summarize the different methods of tunneling suitable to different ground conditions.	K2
CO5	Explain about instrumentation during and after construction of Underground construction.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2
CO2	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2
CO3	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2
CO4	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2
CO5	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2
22CPE$27	3	2	1	1	1	-	-	-	-	-	-	-	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

23CPE$28	GEOTECHNIQUES FOR INFRASTRUCTURE

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire knowledge on the geotechnical engineering problems associated with contaminated soil, transport of contaminants and to select suitable remediation technologies.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Infrastructure projects –Scope and necessity- Importance of Geotechniques in infrastructure projects-Reconnaissance-site selection-factors influencing site selection-guidelines for soil investigation-Geophysical surveys.		
UNIT – II	**SPECIAL FOUNDATIONS**	**9 Periods**
Foundations for industrial plants-Heavy and settlement sensitive structures-Tall structures -Chimneys and Towers-Oil storage tanks-machine foundations- Codal provisions		
UNIT – III	**OFFSHORE STRUCTURES**	**9 Periods**
Types of offshore structures and conceptual development -design methods and Codal Provisions-port infrastructure-break waters-berthing structures-Caissons - General characteristics of offshore soil exploration - Penetrometer - piezocone - vane and pressuremeter techniques.		
UNIT – IV	**TRANSPORTATION INFRASTRUCTURE**	**9 Periods**
Embankment for Road/Rail – bridge foundations-Abutments/Approaches -Tunnelling- parameters influencing location, shape and size - geological aspects -planning and site investigations -Types of underground excavations-deep excavation and shoring systems - Tunnelling by Tunnel Boring Machine.		
UNIT – V	**INSTRUMENTATION AND LAND RECLAMATION**	**9 Periods**
Instrumentation in soil engineering-importance and purpose - Pore pressure measurement - ground water table-strain gauges-Earth pressure cells - Settlement and heave gauges – Inclinometers - Stress measurements - Seismic measurements. Land reclamation in water and swamp area-selection of borrow soil-methods of placement, compaction-monitoring.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Buert. G., Taylor & Francis, **“Hand book of Geotechnical Investigation and Design Tables”**2nd Edition, 2019.*
2	*George P T sinker, **”Port Engineering planning, construction, maintenance and security“**, John Wiley &Sons, Inc.2004.*
3	*Srinivasan, R. (2011). **Harbour, Dock and Tunneling Engineering**, Published by R. C. Pattii, Chal’otar Book Stall, Station Road TulsiSada, Arland (W. Rly), India.*

REFERENCES :

1	*Singh, B and Goel, R. K., **“Tunneling in Weak Rocks”,** Elsevier, 2006.*
2	*Geotechnical Investigation Methods: **A Field Guide for Geotechnical Engineers**. EHUNT, Taylor & Francis, .2006.*
3	*Narayan V.Nayak, **“Foundation Design Manual for Practicing Engineers and Civil Engineering Students”,** Dhanpat Rai Publications Pvt. Ltd., Fourth edition.*
4	*John Dunnicliff (1988). “**Geotechnical Instrumentation for Monitoring Field Performance” ,** A Wiley-Interscience Publication.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Comprehend the importance of site investigation and prepare borelog report	K1
CO2	Choose specific dewatering technique suiting the site requirement.	K2
CO3	Be familiar with various ground improvement techniques	K2
CO4	Recommend suitable offshore investigation techniques	K3
CO5	Recommend alternative solutions to sustain earth pressure.	K3

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	1	1	-	1	-	-	2	2	-
CO2	2	1	1	1	-	1	-	-	-	1	-	1	2	2	2
CO3	2	1	1	1	1	1	1	-	1	1	-	1	2	2	-
CO4	2	2	1	1	-	-	1	-	1	1	-	1	2	2	2
CO5	2	2	1	1	1	1	1	-	-	1	-	-	2	2	2
23CPE$28	2	1	1	1	1	1	1	1	1	1	-	1	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.2,1.3.1,2.1.2,3.1.1,4.1.1,4.1.2,5.3.1,6.1.1,7.2.2,8.1.1,10.1.1.
CO2	1.1.2,1.3.1,2.2.4,2.3.1,3.2.1,3.4.2,4.1.1,4.3.2,6.1.1,10.1.1,12.3.2.
CO3	1.3.1,1.1.2,2.1.2,3.4.2,4.1.4,4.3.3,5.1.2,6.1.1,9.1.2,10.1.1,12.2.1.
CO4	1.3.1,1.2.1,2.1.2,2.2.3,3.1.1,3.3.1,4.1.1,4.2.1,7.1.27.2.2,9.1.1,10.1.1,12.3.2.
CO5	1.3.1,1.2.1,2.2.3,4.1.1,4.2.1,5.1.1,5.1.2,6.1.1,6.2.1,7.1.2,10.1.1.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	20	40	40	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$29	QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To impart knowledge on the building bye -laws and to emphasize the significance of codes of practice in construction sector.	
UNIT – I	**QUALITY MANAGEMENT**	**9 Periods**
Introduction – Definitions and Objectives – Factors influencing Construction Quality – Responsibilities and Authority – Quality plan – Quality Management Guidelines – Quality circles.		
UNIT – II	**QUALITY SYSTEMS**	**9 Periods**
Introduction - Quality System Standard – ISO 9000 family of Standards – Requirements – Preparing Quality System Documents – Quality related Training – Implementing a Quality system – Third Party Certification.		
UNIT – III	**QUALITY PLANNING**	**9 Periods**
Quality Policy, Objectives and Methods in Construction Industry - Consumers Satisfaction, Ergonomics - Time of Completion - Statistical Tolerance – Taguchi's Concept of Quality – Codes and Standards – Documents – Contract and Construction Programming – Inspection Procedures - Processes and Products – Total QA / QC Programme and Cost Implication.		
UNIT – IV	**QUALITY ASSURANCE AND CONTROL**	**9 Periods**
Objectives – Regularity agent, Owner, Design, Contract and Construction Oriented Objectives, methods – Techniques and Needs of QA/QC – Different Aspects of Quality – Appraisals, Factors influencing Construction Quality – Critical, Major Failure Aspects and Failure Mode Analysis, – Stability Methods and Tools, Optimum Design – Reliability Testing, Reliability Coefficient and Reliability Prediction.		
UNIT – V	**QUALITY IMPROVEMENT TECHNIQUES**	**9 Periods**
Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.		
Contact Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1.	*Dr.Kumara Swamy,A.K.Kameswara Rao,* ***"Building Planning and Drawing"****,Charotar Publishing Housing Pvt.Ltd.,2015.*
2.	***"Model Building Bye-Laws (MBBL) – 2016",*** *Town and Country Planning Organization, Ministry of Housing and Urban Affairs, Government of India.*

REFERENCES:

1	***"National Building Code of India 2016 – SP 7",*** *NBC 2016, Bureau of Indian Standards.*
2	***"Model Building Bye-Laws (MBBL) – 2016",*** *Town and Country Planning Organization, Ministry of Housing and Urban Affairs, Government of India.*
3	***"Unified Building Bye-laws for Delhi 2016",*** *Nabhi Publications, 2017.*
4	*Mukesh Mittal* ***"Building Bye Laws",*** *, Graphicart publishers, Jaipur, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Outline the basics of the quality planning in construction industry and quality circle quality	K2
CO2	Describe the quality system and certification need	K2
CO3	Comprehend the quality concepts to be implemented in an industry	K2
CO4	Explain the QC/QA objectives and analysis of quality in construction industry	K2
CO5	Select the improvement techniques for quality	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	2	2	-	1	1	-	1	-	-	-	1	-	1
CO2	1	2	2	2	-	1	1	-	1	-	-	-	1	-	1
CO3	1	2	2	2	-	1	1	-	1	-	-	-	1	-	1
CO4	1	2	2	3	-	1	2	-	1	-	-	1	1	-	1
CO5	1	2	2	3	-	1	2	-	1	-	-	1	1	-	1
22CPE$29	**1**	**2**	**2**	**3**	-	**1**	**2**	-	**1**	-	-	**1**	**1**	-	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1		1.3.1, 2.2.3, 2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO2		1.3.1, 2.2.3, 2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO3		1.3.1, 2.2.3, 2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO4		1.3.1, 2.2.3, 2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2
CO5		1.3.1, 2.2.3, 2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$30	ENERGY CONSERVATION TECHNIQUES IN CONSTRUCTION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To facilitate learners to understand sustainable building designs, energy management, and conservation and energy auditing.	
UNIT – I	**INTRODUCTION TO SUSTAINABILITY AND HEAT TRANSFER IN BUILDING**	**9 Periods**
Overview of Sustainability and Green Buildings, Selection of Site – Preservation and Planning, Influence of Climate on Buildings, Basics of Climatology, Earth – Sun relationship, Solar angles and Sun Path Diagram - Design of Shading Systems - Basics of Thermodynamics, Convection/Radiation Heat Transfer, Heat Gain through various Elements of a Building- Introduction to HVAC.		
UNIT – II	**INDOOR ENVIRONMENTAL QUALITY MANAGEMENT**	**9 Periods**
Thermal comfort – Psychrometry and its applications, Thermal Comfort Models and Case Studies Acoustics – Building Acoustics, Measures, Defects and Prevention of Sound Transmission - Indoor Air Quality – Effects, Design Consideration and Integrated Approach for IAQ management. Visual Comfort – Enhancement strategies for Day Lighting and Artificial Lighting.		
UNIT – III	**RESOURCE MANAGEMENT IN BUILDING**	**9 Periods**
Energy efficiency – Energy Efficiency in Building Envelope, Energy Simulation, Energy Management System – Lighting and Renewable Energy and Energy Audit. Water Efficiency – Planning and Design of Water Management System, Rain Water Harvesting, Water Efficient Design and Fixtures, Treatment and Reuse and Water efficient Landscape System.		
UNIT – IV	**WASTE MANAGEMENT IN BUILDING**	**9 Periods**
Waste Management – Types of Waste and its Treatment Methods, Construction and Demolition Waste Management, Waste Management in Residential, Commercial Buildings, Healthcare Facilities. -Materials – Green Product Certifications - Features of Sustainable Building Materials and Sustainable Alternatives.		
UNIT – V	**LIFE CYCLE ASSESSMENT AND RATING SYSTEM**	**9 Periods**
Life Cycle Assessment and its types – Modelling and Analysis - Greenhouse Gas Emission. Different phases of Green Building Project Management. Green Building Rating Systems- LEED, BREEAM and others, Indian Green Building Rating Systems – IGBC & GRIHA, IGBC Criteria for Certification.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS :

1	*Kibert, C.* ***"Sustainable Construction: Green Building Design and Delivery",*** *John Wiley & Sons, 4th Edition, 2016.*
2	*Satyajit Ghosh, Abhinav Dhaka,* ***"Green structures: Energy efficient buildings",*** *2015.*

REFERENCES:

1	*NPTEL* ***"Energy efficiency acoustics and day lighting in building",*** *Prof.B.Bhattacharjee., IIT Delhi.*
2	*NPTEL* ***"Energy Efficiency and Simulation"*** *Prof.E.Rajsekar., IIT Roorkee.*
3	*Baird, George,* ***"Energy performance of Buildings"*** *C R C Publisher, 2011.*
4	*Ganesan T P,* ***"Energy Conservation in Buildings"*** *ISTE Professional Center, Chennai,1999.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Comprehend sustainable design, climatology, shading system and analyze heat transfer mechanism in buildings.	K2
CO2	Assess the design considerations and parameters for thermal comfort, visual comfort, indoor air quality and acoustics.	K3
CO3	Identify solutions for energy efficiency and water efficiency	K3
CO4	Assess the various waste management in buildings	K3
CO5	Outline the life cycle assessment and rating system	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	3	-	-	-	-	-	3	2	1
CO2	2	2	1	1	1	2	3	1	-	-	-	1	3	2	1
CO3	2	1	1	1	1	2	3	1	-	-	-	2	3	2	1
CO4	2	1	1	1	1	2	3	1	-	-	-	2	3	2	1
CO5	-	1	-	1	-	3	2	-	-	-	-	1	3	2	1
22CPC$30	2	2	1	1	1	3	3	1	-	-	-	2	3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.3.1, 2.3.2, 3.2.3, 4.1.1, 4.3.4, 5.1.2, 7.1.2, 7.2.1, 7.2.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.2.3, 4.1.1, 5.1.2, 5.3.1, 6.1.1, 7.1.2, 7.2.1, 7.2.2, 8.2.2, 12.2.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.2.3, 4.1.1, 5.1.2, 5.3.1, 6.1.1, 7.1.2, 7.2.1, 7.2.2, 8.2.2, 12.1.1, 12.2.2, 12.3.1
CO4	1.2.1, 1.3.1, 1.4.1, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.2.3, 4.1.1, 5.1.2, 5.3.1, 6.1.1, 7.1.2, 7.2.1, 7.2.2, 8.2.2, 12.1.1, 12.2.2, 12.3.1
CO5	2.3.1, 4.1.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 12.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$31	PAVEMENT ENGINEERING					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		**PE**	**3**	**0**	**0**	**3**
Course Objective	To gain knowledge on various IRC guidelines for designing flexible, rigid pavements, to assess the quality, serviceability conditions of roads, evaluation of pavements and strengthening methods					
UNIT – I	**BASIC CONCEPTS**					**9 Periods**
Pavement – Types and components – Function of components - Historical developments – Approaches to pavement design–Vehicle traffic considerations– Behaviour of road materials under repeated loading consideration-Stresses and deflections in Layered systems.						
UNIT – II	**FLEXIBLE PAVEMENT**					**9 Periods**
Factors affecting flexible pavement-Various approaches of design – Empirical, Semi-empirical and theoretical methods – Applications of different pavement design methods- Design procedure as per IRC design guidelines-Failure criteria for bituminous pavement.						
UNIT – III	**RIGID PAVEMENT**					**9 Periods**
Cement concrete pavement-Factors affecting CC Pavement – Modified Westergaard approach–Design procedure as per IRC design guidelines– Types of joints and their functions– Design of joints.						
UNIT – IV	**PAVEMENT MATERIALS**					**9 Periods**
Pavement materials – Aggregate characteristics and test – Crushing – Abrasion – Impact Tests – Water absorption – Flakiness and Elongation indices. Field compaction – Rammers – Rollers – Compaction control – In-situ density –- Bitumen Emulsion and cutback –Preparation and characteristics uses and tests, mechanism of stripping, adhesion failure–. Bituminous mixes: preparation, design and testing.						
UNIT – V	**EVALUATION AND REHABILITATION**					**9 Periods**
Pavement evaluation – Distress in flexible and rigid pavements –Evaluation based on surface Appearance, Cracks, Patches, potholes and skid resistance - Structural evaluation – Evaluation by deflection measurements - Present Serviceability Index — Strengthening of pavements –Flexible and rigid overlays.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, **"Highway Engineering"**, Khanna Publishers,Tenth Edition,2013*
2	*Yoder, E.J and Witchak, M.W, **"Principles of Pavement Design"**, e print, Newyork wiley, 2010.*

REFERENCES:

1	*Kadiyali, L.R and N.B.Lal., **"Transport planning & Traffic Engineering"**, Khanna Publishers, 2016.*
2	*S.K Sharma, **"Principles, Practice and Design of Highway Engineering"**, S. Chand & Co.,Ltd., New Delhi, 2014.*
3	*Guidelines for the Design of Flexile Pavements, IRC: 37-2012, The Indian roads congress, NewDelhi*
4	*Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC: 58-2015, TheIndian Roads Congress, New Delhi*
5	*IRC SP20-2002, Design and specification of Rural Roads (Manual), Ministry of rural roads,Government of India, New-Delhi, Reprint 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explore the pavement categories, aspects, and stresses in flexible pavement.	K2
CO2	Implement different methods when designing flexible pavements.	K3
CO3	Analyze the stresses and apply IRC standards for rigid pavement design.	K3
CO4	Develop adequate knowledge of the different quality control tests.	K1
CO5	Evaluate the various pavement distresses and strengthening techniques.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3		1	1	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	2	-	-	-	-	-	-	2	-	-
CO3	3	3	2	1	1	2	-	-	-	-	-	-	2	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-	-	1	-
22CPE$31	3	3	2	1	1	2	-	-	-	-	-	-	2	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.4,3.1.5,4.3.3,5.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.3.3,5.3.1,5.3.2,6.1.1
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.1,3.4.1,4.1.1,4.3.3,5.3.1,5.3.2,6.1.1
CO4	1.2.1,1.3.1,1.4.1,2.1.3,2.2.4,2.3.2,2.4.2,3.1.1
CO5	1.2.1,1.3.1,1.4.1,2.1.3,2.2.4,2.3.2,2.4.2,3.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$32	AIRPORT, DOCKS AND HARBOUR ENGINEERING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	3	3

Course Objectives	To explore the planning aspect, components design and construction of Airport, Docks and Harbour.	
UNIT – I	**AIRPORT PLANNING AND RUNWAY**	**9 Periods**
Air transport-development in India – AAI-ICAO, Aircraft characteristics. Airport Planning –Regional planning-site selection – surveys- estimation of air traffic needs. Airport Obstructions – Classification- Approach zone-turning zone. Runways – Orientation – Wind rose diagram - Basic runway length-corrections – Geometric Design-runway patterns.		
UNIT – II	**TAXIWAY AND AIRPORT LAYOUTS**	**9 Periods**
Taxiway – Geometric design –exit taxiway-holding apron. Airport layouts - Apron –Hangars - Terminal buildings - Airports buildings - Passenger flow -Passenger facilities.		
UNIT – III	**VISUAL AIDS, PAVEMENTS AND AIRPORT DRAINAGE**	**9 Periods**
Visual Aids – Runway and Taxiway Markings-Runway and Taxiway Lightings - Air Traffic Control – Basic Actions. Runway pavements – types (Introduction) – construction (no design problems)- Failures of runway pavement – maintenance. Airport drainage (Introduction only).		
UNIT – IV	**HARBOUR, PORTS AND DOCKS**	**9 Periods**
Water transportation – Introduction. Tides. Harbour – classification – site selection Port – classification- Requirements-facilities. Docks – wet docks – dry docks.		
UNIT – V	**BREAK WATER, NAVIGATIONAL AIDS AND DREDGING**	**9 Periods**
Break water-Types-construction methods. Berthing structures – quays, piers, wharves, dolphins, jetties, fenders. Navigational aids- Necessity-Light houses –signals-Mooring- Mooring accessories. Dredging-Types.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*S. K. Khanna, M. G. Arora, S. S. Jain* ***"Airport planning and design"****, S.Chand and bros, 2009.*
2	*Srinivasan.R.,* ***"Harbour, Dock and Tunnel Engineering"****, Chartor publishing house, Anand,India,2004.*

REFERENCES:

1	*Rangwala ,* "***Airport Engineering***"*, 13th Edition, Charotar Publishing House Pvt. Ltd, Anand India, 2012.*
2	*Vazirani.V.N and Chandola.S.P.,* ***"Transportation and Engineering, Vol.2"****, Khannapublishers, New Delhi,2005.*
3	*Subramanian K.P.,* ***"Highways, Railways, Airport and Harbour Engineering"****, Scitech Publications (India), Chennai,2010.*
4	*Hasmukh P. Oza, Gautam H. Oza,* ***"Dock And Harbour Engineering",*** *8th Edition,Charator publishing house private limited, Gujarat, 2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Prepare the select appropriate site for airport and design of runway	K3
CO2	Plan the airport layout and selection of components of airport	K3
CO3	Identify the visual aids of airport and also able to construct and maintenance of runway	K2
CO4	Prepare the layout and design of harbor, ports and dock	K3
CO5	Categorize the protection and berthing structures	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO2	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO3	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO4	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO5	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
22CPE$32	3	3	1	3	3	-	-	-	-	-	-	1	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$33	HIGHWAYS - STATE OF ART

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To impart an overview on the design and construction of various types of highways, tendering and accounting procedures of Tamil Nadu Highways department.	
UNIT – I	**HIGHWAYS - OVERVIEW**	**9 Periods**

Highway Planning in India:
Classification and Authorities of roads in India – Function and duties of Ministry of Road Transport and Highways (MORTH) and Indian Roads Congress (IRC) - Highways Research centers in India – Financing of Highways Infrastructures.
Tamilnadu Highways Department organizational setup and duties - Project Announcements - Financial Allotment - Government Orders - Issue of Letter of Credit.
Geometric elements of Highways:
Terrain, Land width, Building lines and Control lines, Right of Way, Carriage Way, Camber, Kerbs,Shoulders, Side slopes, Footpaths, Sight distances, horizontal and vertical alignments
[IRC Standards]
Typical cross section - Components of bridge structures.

UNIT – II	**DESIGN AND CONSTRUCTION OF HIGHWAYPAVEMENTS**	**9 Periods**

Desirable properties and quality assurance tests of materials for flexible and rigid pavements - Design of bituminous paving mixes - Design factors for flexible and rigid pavements - Design of flexible pavement using IRC:37 – Design of bituminous overlay using IRC:81 - Design of rigid pavements using IRC:58.

UNIT – III	**DESIGN AND CONSTRUCTION OF BRIDGES**	**9 Periods**

Engineering Surveys for Alignment of road bridges - Investigations for bridge works and preparationof field particulars - linear waterway calculation.
Classification of bridges – Basics of bridge design and drawings – Construction practices in Bridges -RMC site machineries and operations – Construction site machineries and operations - Quality Assurance activities at plant and construction sites.
Grade Separators and Elevated Structures:
Basics - Common types of Interchanges - Trumpet interchange, Diamond interchange, Cloverleaf interchange, Rotary interchange and Directional interchange - General features and Geometric Standards – Construction problems.

UNIT – IV	**HIGHWAY MAINTENANCE**	**9 Periods**

Road maintenance:
Basic objectives – Classification of maintenance activities – Procedure for inspection and planning maintenance works – Surface and subsurface drainage of roads – Road markings and appurtenances.
Pavement failures:
Defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments; Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structuralcracks, Spalling of joints and Mud pumping - Treatments.

Hill roads:
Construction and maintenance - V shaped drains, Shadow and swamp areas, landslide - causes, investigation, preventive and remedial measures - protection of embankment and cut slopes – flood damage and emergency works – problems and remedial measures in hill road construction.
Applications of geosynthetics, reinforced earth and soil nailing in highways.

UNIT – V	**TENDERING AND ACCOUNTING PROCEDURES**	**9 Periods**

Tendering:
Estimate preparation and sanctions – tendering and contracting procedures, laws of contracts – COTapproval – agreements.
Accounting:
Recording measurements – bill preparation and processing – Working estimates – RAS – disputes andarbitration - Completion Certificates - Completion Report - Internal Audit and Accountant General Audit.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1	*T.F. Fwa, **"The Handbook of Highway Engineering"**, CRC Press, 2006.*
2	*S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, "**Highway Engineering**", Khanna Publishers, Tenth Edition, 2014.*

REFERENCES:

1	*Fred L. Mannering, Scott S. Washburn, **"Principles of Highway Engineering and Trafficanalysis"**, John Wiley and Son, 2017.*
2	*E.J.Yoder and M.W.Witczak, **"Principles of Pavement Design"**, e- Print, Newyork Wiley,2010.*
3	*Kadiyali L R, **"Principles & Practice of Highway Engineering"**, Khanna Publishers, 2005.*
4	*Specifications for Road and Bridge works, MORT&H (Fifth Revision)April 2013*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Categorize different types of highways and geometric elements of highways.	K2
CO2	Design and construct both flexible and rigid pavements based on IRC guidelines.	K2
CO3	Apply the knowledge on engineering surveys for road bridges and construction procedures in bridge design.	K3
CO4	Acquaint on different aspects of pavements and hilly roads.	K3
CO5	Prepare the tender documents as per the specifications of Tamil Nadu Highways department.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO2	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO3	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO4	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO5	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
22CPE $33	3	3	1	3	3	-	-	-	-	-	-	1	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.1,5.3.2,12.1.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.1,5.3.2,12.1.1
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.1,5.3.2,12.1.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.1,5.3.2,12.1.1
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2, 5.3.1,5.3.2,12.1.1

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$34	TRAFFIC ENGINEERING AND MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To gain knowledge on the traffic surveys, signals, safety aspects and traffic management projects.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Scope– Properties of traffic engineering elements – vehicle, driver and road characteristics - skid resistance and breaking efficiency – simple problems. Components of traffic Engineering – control mechanisms.		
UNIT – II	**TRAFFIC SURVEYS**	**9 Periods**
Surveys – Classification - Volume, Speed and delay, origin and destination - parking, accidents – stastical methods for traffic engineering – simple problems – analysis-capacity of roads-level of service – interpretation of traffic studies and conclusions.		
UNIT – III	**TRAFFIC CONTROL**	**9 Periods**
Traffic signs – location and design recommendations - Road markings – Classification and design of traffic signals –signal co-ordination – Traffic islands and rotaries – Traffic control aids and street furniture – Regulation of traffic –Modern methods of traffic control.		
UNIT – IV	**TRAFFIC SAFETY AND MANAGEMENT**	**9 Periods**
Road accidents – types - causes and prevention with emphasis on engineering factor s – Traffic management, Transport system management (TSM) and Transport Demand Management (TDM), restrictions on turning movements, one way streets, traffic segregation, tidal flow operation, exclusive bus lanes and other management measures – introduction to intelligent transport systems (ITS).		
UNIT – V	**TRAFFIC MANAGEMENT PROJECTS**	**9 Periods**
Design of parking facilities, on street and off street parking – case studies on area traffic management – street lighting –noise and air pollution abatement – Basis of comprehensive traffic and transport studies – intersection improvements including design of roundabouts.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Kadiyali.L.R,* ***"Traffic Engineering and Transport planning"****, Khanna Publishers, 2011.*
2	*Salter.R.I., and Hounsell.N.B,* ***"Highway Traffic Analysis and Design"****, Macmillan Press Ltd., 2000.*

REFERENCES:

1	***Manual of Transportation Engineering studies****, Institution of Transportation Engineering, Prentice hall Publications, 1994.*
2	*Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning And Management*
3	*John.E.Tyworth.,* ***"Traffic Management Planning"****, Operation and Control, Addison Wesley Publishing Company, 1997.*
4	*Fred L. Mannering, Scott S. Washburn and Walter P. Kilareski,* ***"Principles of Highway Engineering and Traffic Analysis"****, Wiley India Pvt. Ltd., New Delhi,2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Express the details of traffic elements and their characteristics.	K2
CO2	Conduct various traffic surveys.	K2
CO3	Perform design of traffic signals.	K3
CO4	Analyse the causes and control measures of road accidents.	K3
CO5	Design of parking facilities with improved intersection points.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO2	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO3	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO4	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
CO5	2	2	1	2	3	-	-	-	-	-	-	1	1	2	2
22CPE$34	3	3	1	3	3	-	-	-	-	-	-	1	1	2	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,3.1.1,4.1.1,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,12.1.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$35	TOWN PLANNING AND ARCHITECTURE

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To study and analyse the various typologies of housing related to Architectural design, area distribution and various land uses of a housing layout.	
UNIT – I	**TOWN PLANNING**	**9 Periods**
History of evolution of town- Town and environment – Elements of city plan- Importance of Climate ,humidity ,wind and radiation - surveys and data collection – Residential neighbourhood – Industrial areas – Public buildings – Housing and slum clearance.		
UNIT-II	**BUILDING RULES AND GUIDELINES**	**9 Periods**
General – Zoning regulation – regulation regarding layouts – master plan – regional plan- structural plan – building regulations-Rules for special types of buildings- Floor space index- minimum plot size and building front age- Open spaces- Minimum standard dimensions of building elements- Provision for lighting and ventilation- Provision for means of access - Land use classification- Town planning standards.		
UNIT – III	**ELEMENTS OF ARCHITECTURE**	**9 Periods**
Introduction of Architecture- Definition- factors influencing architectural development - Mass and Space visual effects of geometric forms and their derivatives- The sphere, the cube, the pyramid, the cylinder and cone- The aesthetic qualities of Architecture- Proportion, scale, balance, symmetry, rhythm and axis-contrast in form- Harmony.		
UNIT – IV	**PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS**	**9 Periods**
General- Factors affecting orientation- Sun- Wind- Rain- Orientation criteria for Indian conditions- Principles governing the theory of planning- Planning of Residential buildings- Electrification of buildings ,Intelligent buildings.		
UNIT – V	**INTRODUCTION TO INTERIOR DESIGN**	**9 Periods**
General – decorative materials – cement Bonded Board (BISTON PANEL), water proof cement paint Industrial glazing and Roofing, unit masonry, plaster and dry wall, Wall surface materials, Effect o colour on architecture- Home furnishing- Plans in rooms. Estimation, specifications, valuations professional practices, House furnishing-Plans in rooms.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXTBOOKS:

1	*Margaret Roberts, **"An Introduction to Town Planning Techniques"**, Hutchinson, London, 1990.*
2	*Edward D. Mills, **"Planning the Architects Handbook"**, Butterworth London, 1995.*

REFERENCES:

1	*Hiraskar, G.K., **"Fundamentals of Town Planning"**, Dhanpat Rai Publications, 1992.*
2	*NBC, local town planning authority rules and regulations*
3	*Francis D.K. Ching, **"Architecture: Form, Space and order"**, VNR, N.Y., 1999.*
4	*A.Bandopadhyay, **"Town Planning"** , Books and Allied, Calcutta 2000*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Describe the importance of various components of town planning.	K2
CO2	Execute the town planning standards and guidelines.	K3
CO3	Apply the suitable elements in architectural design.	K3
CO4	Plan a building based on orientation criteria.	K3
CO5	Select the decorative materials for interior design.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO 3
CO1	2	1	1	1	-	2	-	-	1	-	-	-	3	3	3
CO2	2	1	1	1	-	2	-	-	1	-	-	-	2	3	3
CO3	2	1	1	1	-	-	-	-	-	-	-	-	2	3	3
CO4	2	1	1	1	-	2	-	-	1	-	-	-	2	3	3
CO5	2	1	1	1	-	-	-	-	-	-	-	-	3	3	3
22CPE $35	2	1	1	1	-	2	-	-	1	-	-	-	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,,2.1.3,2.2.3,,3.1.5,4.1.1,4.2.1,4.3.1,6.2.1,9.1.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.3,3.1.4,3.1.5,4.1.1,4.2.1,,6.2.1,9.1.2
CO3	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,3.1.5,4.1.1,4.2.1
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,3.1.4,3.1.5,4.1.1,4.2.1,4.3.1,6.2.1,9.1.2
CO5	1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.3,3.1.5,4.1.1,4.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$36	IOT PLATFORM FOR SMART CITY PLANNING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To develop basic IOT functional and networking aspects, their role in Smart Cities, apply the basic needs and planning concept to solve various Infrastructure problems using IOT.	
UNIT – I	**INTERNET OF THINGS**	**9 Periods**
Introduction to Internet of Things, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures – Sensors/ Devices, Connectivity, Data Processing.		
UNIT – II	**IOT STANDARDS AND SMART CITIES**	**9 Periods**
Introduction to smart cities- Definition, dimensions and scope of Smart Cities –Global Standards and Performance Benchmarks, Practice Code. India "100 Smart Cities" Policy and Mission – Worldwide policies for smart city - Government of India policy for smart city, Mission statement & guidelines, Smart cities in India.		
UNIT – III	**ADVANCEMENT IN SMART CITY INFRASTRUCTURE**	**9 Periods**
Energy and ecology, solar energy for smart city - Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management - Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system.		
UNIT – IV	**SMART TRANSPORT PLANNING**	**9 Periods**
Introduction to smart transport, Intelligent transportation system (ITS), GIS and GPS positioning Navigation and Identification system, Smart Automobiles and sustainable fuels, smart pedestrian walkways and cycle tracks, solar roads, electronic fee payment technology, electronic speed determination technology, and smart signaling technology.		
UNIT – V	**IOT APPLICATIONS IN SMART CITIES**	**9 Periods**
Application of IOT in Smart energy– Smart water management - Smart Parking -Smart metering – Lighting as service - Smart solid waste management - Smart mobility – Smart governance - Case studies of the smart city.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Olivier Hersent, David Boswarthick and Omar Elloumi, "**The Internet of Things: Key Applications and Protocols**", Second Edition, Wiley Publisher, 2012.*
2	*Vincenzo Piuri , Rabindra Nath Shaw , Ankush Ghosh, "**AI and IoT for Smart City Appications (Studies in Computational Intelligence, , 1002)",** Springer ,1st edition, 2022.*

REFERENCES:

1	*K. Saravanan , G. Sakthinathan, "**Handbook of Green Engineering Technologies for Sustainable Smart Cities (Green Engineering and Technology)**" CRC Press,1st Edition, 2021.*
	*Shrimoyee Bhattacharya, Sujaya Rathi "**Reconceptualising Smart Cities: A Reference Framework For India**" India International Center , 2015*
2	*Surjeet Dalal, Vivek Jaglan , Dac-Nhuong Le, **"Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges (Green Engineering and Technology)",** CRC Press, 1st Edition, 2021.*
3	*Massimo La Scala, Sergio Bruno Carlo Alberto Nucci S. Lamonaca, Ugo Stecchi "**From Smart Grids to Smart Cities: New Challenges in Optimizing Energy Grids**", Wiley-ISTE, 1st Edition, 2021.*
4	*Gerardus Blokdyk," **Smart City a Complete Guide,** 5STARCooks, 2019 Edition, 2021.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Summarize the concepts of the IoT.	K2
CO2	Interpret IOT standards to plan smart cities.	K3
CO3	Identify components and techniques of infrastructure in smart city planning.	K3
CO4	Develop smart transport systems for smart cities.	K2
CO5	Formulate smart city plans using IOT in different sectors.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	2	3	3	3	3	-	-	1	1	3	2	1	-
CO2	2	1	2	3	3	3	3	-	-	1	1	3	2	1	-
CO3	2	1	2	3	3	3	3	-	-	1	1	3	2	1	-
CO4	2	1	2	3	3	3	3	-	-	1	1	3	2	1	-
CO5	2	3	2	3	3	3	3	1	-	1	1	3	2	1	-
22CPE$37	2	1	2	3	3	3	3	1	-	1	1	3	2	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO5	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,8.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Rememberi ng (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$37	INTELLIGENT BUILDING TECHNIQUES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To integrate and optimize the building structures, systems, services and management in order to create a productive, cost effective and environmentally approved environment for the building occupants	
UNIT – I	**INTRODUCTION TO INTELLIGENT BUILDINGS**	**9 Periods**
Basic concepts – Intelligent building automation – Cost analysis – Smart materials and embedded sensor technology – BAS communication standards – BACnet, Lon Works, PROFIBUS, Modbus, EIB – Building management system and energy savings – Application of AI research to building systems.		
UNIT – II	**INTELLIGENT SYSTEMS AND MANAGEMENT**	**9 Periods**
Basic Heating, Ventilation and Air Conditioning (HVAC) system – Sensor – Occupancy sensors and temperature sensors – Energy efficient HVAC systems – Thermal energy storage – Control and optimization of Air Conditioning systems – Automated car parking management.		
UNIT – III	**INTELLIGENT SAFETY AND SECURITY SYSTEMS**	**9 Periods**
Life safety factors – Intrusion sensors – Space sensors – CCTV systems, Access – control systems, Burglar alarm systems – Microprocessor based alarm – RFID enabled access control – System integration and convergence – Fire protection systems – Integration of fire alarm systems with other systems.		
UNIT – IV	**BUILDING ELECTRONICS**	**9 Periods**
Microprocessor based control – Programmable logic controller – Communication principles – Telephone systems – Communal aerial broadcasting – Satellite communication – Fibre optic system – Applications – Case studies.		
UNIT – V	**INTELLIGENT BUILDING PERFORMANCE**	**9 Periods**
High performance buildings – Control theory – Market trends – Energy efficiency – Emerging HVAC technologies for high performance buildings – Environmental and greenhouse gas emission reduction – Clean development systems – Practical benefits – Smart home – Smart office – Case studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Shengwei Wang, **"Intelligent Buildings and Building Automation",** Spon Press, London, 2010.*
2	*Derek Clements Croome, **"Intelligernt Building: Design, Management and Operations",** ICEP Publishers, London, 2014.*

REFERENCES:

1	*Ehrlich, C., **"Intelligent Building Dictionary: Terminology for Smart, Integrated Green Building Design, Construction, and Management",** San Francisco, Handson–Guide, 2007.*
2	*Xinyan Huang., **"Intelligent Building Fire Safety and Smart Firefighting"**,Springer Cham, 2024.*
3	*John T. Wen, Sandipan Mishra, **"Intelligent Building Control Systems, A survey of Modern Building Control and Sesing Strategies"** Springer International Publishing AG, 2018.*
4	*Hermann Merz., **"Building Automation – Communication systems with EIB/KNX, LON and BACnet",** Springer Berlin, Heidelberg, 2009.*
5	*Zhiqiang John Zhai, **"Energy Efficient Buildings: Fundamentals of Building Science and Thermal Systems",** 2022.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Indicate and fix the materials and technology involved in the intelligent buildings.	K2
CO2	Choose the appropriate comfort systems and fabricate the HVAC system efficiently and effectively.	K3
CO3	Execute ample safety measures that are required for the building to prevent accidents in building.	K2
CO4	Select correct electronic components and construct a state of art built in electronic systems.	K3
CO5	Assess the performance of buildings in terms of energy efficiency, clean environment and air pollution.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	1	-	-	-	2	1	3	2	1
CO2	3	3	2	1	1	2	1	-	-	-	1	1	2	2	1
CO3	2	2	2	1	1	3	1	-	-	-	1	1	2	2	1
CO4	3	2	2	1	1	2	1	-	-	-	1	1	2	1	1
CO5	3	3	2	2	2	2	1	-	-	-	2	1	3	2	1
22CPE$37	3	3	2	2	2	2	1	-	-	-	2	1	3	2	1
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.2, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.3.1, 4.3.2, 4.3.4, 5.2.1, 5.2.2, 5.3.1, 6.2.1, 7.1.1, 11.1.1, 11.3.1, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.4, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.3.1, 4.3.4, 5.2.1, 5.3.2, 6.2.1, 7.1.2, 11.1.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.4.4, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.3.1, 4.3.4, 5.2.1, 6.1.1, 6.2.1, 7.2.2, 11.1.1, 12.3.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4, 2.4.4, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.3.1, 4.3.4, 5.2.1, 5.2.2, 6.2.1, 7.1.2, 11.1.1, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.2, 2.4.4, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 4.1.2, 4.1.4, 4.3.1, 4.3.4, 5.2.1, 5.3.1, 5.3.2, 6.2.1, 7.1.2, 11.1.1, 11.2.1, 11.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$38	GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT

PREREQUISITES		CATEGORY	L	T	P	C
NIL		PE	3	0	0	3
Course Objectives	To provide an exposure of GIS role in smart city, types of infrastructures in smart city development and GIS enabled smart transportation techniques.					
UNIT – I	**INTRODUCTION TO REMOTE SENSING AND GIS**	**9 Periods**				
Geographical Information System – Remote Sensing Concepts Electro Magnetic Spectrum – Spectral Signature –Spectroradiometer – Types of Remote Sensing – Optical, Thermal, Hyper spectral, Microwave Remote Sensing.						
UNIT – II	**FUNDAMENTALS OF URBAN DEVELOPMENT**	**9 Periods**				
Smart city development – Fundamentals – Sustainability – Infrastructure – Physical Infrastructure Housing, Sewerage, Transport etc. – Social Infrastructure – Health, Education – Institutional Infrastructure, Planning and management – Economic Infrastructure – GDP and Employment.						
UNIT – III	**LAND USE/ LAND COVER MAPPING**	**9 Periods**				
Acquisition of digital image – Settlement – Land use/Land cover Mapping – Vector data – Digitization – Object delineation – Digital Elevation Model (DEM) Urban Sprawl – High resolution remote sensing data.						
UNIT – IV	**GIS NAVIGATION TECHNIQUES**	**9 Periods**				
Urban and regional transportation corridors Optimum route and plans / shortest path – Alignment planning, Traffic and flow management – Smart Street lights – Efficient Parking.						
UNIT – V	**GIS IMPLEMENTATION**	**9 Periods**				
Smart governance – Information and Communication Technology (ICT) – Use of sensors Water management, Waste management – Energy management– Air Pollution management GIS Role Revenue and Tax, collection– Planning Facilities and Amenities – Accident Analysis – Crime Mapping.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Period Practical: 0 Period Total: 45 Periods**						

TEXT BOOKS:

1	*Juliana Maantay, John Ziegler, John Pickles, "**GIS for the Urban Environment**", Esri Press 2006.*
2	*Said Easa, Yupo Chan, **"Urban Planning and Development Applications of GIS"**, Amer Society of CivilEngineers, 1999.*

REFERENCES:

1	*A M Chandra, S.K.Ghosh, **"Remote Sensing and Geographical Information system",** Narosa, Publishing house New Delhi, 2006.*
2	*Kang tsung Chang, **"Introduction to Geographic Information Systems",** 9th Edition, 2019, McGraw Hill Book Company, ISBN: 9781259929649*
3	*S.C.Bhatia **,"Fundamentals of Remote sensing",** , Atlantic Publishers & Distributions (P) Ltd, 2008.*
4	*Paul A. Longley, Michael F. Good child, David J. Maguire, David W. Rhind, **"Geographic Information Science and Systems"**, Wiley 4th Edition , 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Know the principles of GIS of in smart city planning.	K1
CO2	Plan the smart city and various types of infrastructure requirements.	K2
CO3	Get idea of various existing terrain with the help of satellite images.	K2
CO4	Apply various spatial analysis tools for deriving GIS based outcome	K3
CO5	Implement the GIS ideologies across different sectors	K3

COURSE ARTICULATION MATRIX:

CO and PO Mapping

PO/ PSO **CO**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	1	1	1	1	1	-	-	-	-	-	2	2	-
CO2	2	-	1		-	1	-	-	1	1	1		2	2	-
CO3	2	1	-	1	1	1	1	-		1	1	1	3	2	2
CO4	2	1	1	-	1	1	1	-	1		1	1	2	2	2
CO5	2	1	1	-	1	1	1	-	1	1	1	1	2	3	2
22CPE$38	2	1	1	1	1	1	1	-	1	1	1	1	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,3.1.1,3.4.2,4.3.1,6.1.1,7.2.1,7.1.2.
CO2	1.2.1,3.2.1,6.1.1,9.3.1,10.1.1,11.3.2.
CO3	1.2.1, 2.3.1,4.1.1,5.2.2,6.1.1,7.1.2,10.1.1,11.3.2,12.1.1.
CO4	1.2.1,2.2.2,3.1.5,5.1.1,5.2.2,6.1.1,7.1.2,9.1.2,11.1.1,12.2.1,12.3.1.
CO5	1.2.1,1.3.1,2.1.2,3.1.1,5.2.1,6.1.1,7.1.1 ,7.1.2,7.2.1,9.1.1,10.3.2,11.1.1,12.2.1.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1/ Case Study 1/ Seminar 1/ Project1	40	40	20	-	-	-	100
Individual Assessment 2/ Case Study 2/ Seminar 2/ Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$39	**ROBOTICS AND AUTOMATION**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**PE**	**3**	**0**	**0**	**3**

Course Objective	To understand the potentiality and applicability of Robotics, Automation and Artificial Intelligence to various facets of Civil engineering.	
UNIT – I	**INTRODUCTION TO ROBOTICS AND AUTOMATION**	**9 Periods**
Definition - Basic Principles of Robotics and Automation - Historical Perspective and Evolution, - Applications in Civil Engineering - Types of Sensors used in Civil Engineering Applications - Actuators and their role in Automation - Integration of Sensors and Actuators in Robotic Systems		
UNIT – II	**ROBOTICS PRINCIPLE AND APPLICATION IN CONSTRUCTION**	**9 Periods**
Basics of Robot Motion and Manipulation - Forward and Inverse Kinematics - Dynamics of Robot Motion - Autonomous Construction Vehicles - Robotic Construction Equipment - Robotic Assembly and Fabrication in Construction		
UNIT – III	**AUTOMATION IN CIVIL ENGINEERING**	**9 Periods**
Automated Inspection and Maintenance of Structures- Robotic Construction of Buildings and Bridges-Structural Health Monitoring using Automation - Automated Soil Sampling and Testing- Autonomous Drilling and Excavation in Geotechnical Applications- Robotics in Tunneling and Underground Construction		
UNIT – IV	**HUMAN-ROBOT COLLABORATION**	**9 Periods**
Human-Robot Collaboration - Collaborative Robots in Civil Engineering - Safety Considerations in Human- Robot Interaction - Case Studies of Successful Human-Robot Collaboration in Construction - Robotics in Disaster Response and Recovery: Use of Robots in Disaster-Stricken Areas - Search and Rescue Robotics - Automated Infrastructure Inspection after Disasters		
UNIT – V	**MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE IN CIVIL ENGINEERING**	**9 Periods**
Introduction to Machine Learning and AI - Applications in Predictive Maintenance- AI-Driven Decision-Making in Civil Engineering Project- Neural Networks - Introduction, Models, and its Application in Civil Engineering - Fuzzy Logic and its Application in Decision Making;		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*S. Mukherjee, **"Robotics Process Automation"** Khanna Book Publishing, 2021.*
2	*Asitava Ghoshal, **"Robotics: Fundamental concepts and analysis"** Oxford University Press, 2006.*

REFERENCES:

1	*Dilip Kumar Pratihar, **"Fundamentals of Robotics"** Narosa Publishing House, 2019.*
2	*M.C. Trivedi, **"A Classical Approach to Artificial Intelligence"** Khanna Book Publishing, 2023.*
3	*Sabrie Soloman, **"Advanced Robotics"** Khanna Book Publishing Co., 2023.*
4	*John J. Craig, **"Introduction to Robotics"**, Pearson Education Inc., Asia, 3rd Edition, 2005.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Comprehend the principle of actuator sensor in robotic and automation	K2
CO2	Outline principle and benefits of robotics in construction	K2
CO3	Select the Automation techniques in construction industry	K2
CO4	Identify the important of human-robot Collaboration in Disaster management	K2
CO5	Classify application of AI, Machine Learning, Neural network and Fuzy Logic in construction industry	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	-	1	-	-	-	-	-	-	-	-	1	1	2	1
CO2	2	-	1	-	1	-	-	-	-	-	-	1	1	2	1
CO3	2	-	1	1	1	-	-	-	-	-	-	1	1	2	1
CO4	2	-	1	-	1	-	-	-	-	-	-	1	1	2	1
CO5	2	-	1	1	1	-	-	-	-	-	-	1	1	2	1
22CPE$39	2	-	1	1	1	-	-	-	-	-	-	1	1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 3.1.5, 12.2.1
CO2	1.2.1, 1.3.1, 1.4.1, 3.1.5, 5.1.1,12.3.1
CO3	1.2.1, 1.3.1, 1.4.1, 3.1.5, 4.1.2, 5.1.1, 12.3.1
CO4	1.2.1, 1.3.1, 1.4.1, 3.1.5, 5.1.1, 12.3.1
CO5	1.2.1, 1.3.1, 1.4.1, 3.1.5, 4.1.3, 5.1.1, 12.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$38	GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT

PREREQUISITES		CATEGORY	L	T	P	C
NIL		PE	3	0	0	3
Course Objective	To explore GIS's pivotal role in smart city development, covering fundamentals, infrastructures, land use mapping, and GIS-enabled transportation techniques.					
UNIT – I	**INTRODUCTION TO REMOTE SENSING AND GIS**	**9 Periods**				
Geographical Information System – Remote Sensing Concepts Electro Magnetic Spectrum – Spectral Signature – Spectroradiometer – Types of Remote Sensing – Optical, Thermal, Hyper spectral, Microwave Remote Sensing.						
UNIT – II	**FUNDAMENTALS OF URBAN DEVELOPMENT**	**9 Periods**				
Smart city development – Fundamentals – Sustainability – Infrastructure – Physical Infrastructure Housing, Sewerage, Transport etc. – Social Infrastructure – Health, Education – Institutional Infrastructure – Planning and management – Economic Infrastructure – GDP and Employment						
UNIT – III	**LAND USE/ LAND COVER MAPPING**	**9 Periods**				
Acquisition of digital image – Settlement – Land use/Land cover Mapping – Vector data – Digitization – Object delineation – Digital Elevation Model (DEM) – Urban Sprawl – High resolution remote sensing data.						
UNIT – IV	**GIS NAVIGATION TECHNIQUES**	**9 Periods**				
Urban and regional transportation corridors Optimum route and plans / shortest path – Alignment planning – Traffic and flow management – Smart Street lights – Efficient Parking.						
UNIT – V	**GIS IMPLEMENTATION**	**9 Periods**				
Smart governance – Information and Communication Technology (ICT) – Use of sensors Water management – Waste management – Energy management– Air Pollution management GIS Role Revenue and Tax collection – Planning Facilities and Amenities – Accident Analysis – Crime Mapping.						
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOKS:

1	*Juliana Maantay, John Ziegler, John Pickles, "**GIS for the Urban Environment**", Esri Press 2006*
2	*Said Easa, Yupo Chan, **"Urban Planning and Development Applications of GIS"**, Amer Society of Civil Engineers, 1999*

REFERENCES:

1	*A M Chandra, S.K.Ghosh, **"Remote Sensing and Geographical Information system"**, Narosa, Publishing house New Delhi, 2006.*
2	*Kang tsung Chang, **"Introduction to Geographic Information Systems"**, 9th Edition, 2019, McGraw Hill Book Company, ISBN: 9781259929649*
3	*S.C.Bhatia **,"Fundamentals of Remote sensing",** , Atlantic Publishers & Distributions (P) Ltd, 2008.*
4	*Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, **"Geographic Information Science and Systems"**, Wiley 4th Edition, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Evaluate the principles of GIS in smart city planning	K2
CO2	Develop plans for smart cities and identify diverse infrastructure requirements	K3
CO3	Interpret various terrains using satellite images	K3
CO4	Utilize spatial analysis tools to derive GIS-based outcomes	K3
CO5	Implement GIS ideologies across different sectors	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO2	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO3	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO4	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO5	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
22CPE$40	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPE$39	IOT IN CONSTRUCTION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To impart knowledge on the physical, logical design, components and standards of IoT along with the working platform for different systems.	
UNIT – I	**INTRODUCTION TO IOT**	**9 Periods**
Definition and characteristics of IoT - Physical and logical design of IoT - IoT enabling technologies –IoT levels &deployment templates - IoT design methodology - Components of Internet of Thing devices: Control units – Sensors– Communication modules – Power sources. Communication technologies: RFID – Bluetooth – Zig Bee – Wi-Fi –RF links – Mobile Internet – Wired Communication. Safety – privacy – trust - security model		
UNIT – II	**IOT ARCHITECTURE**	**9 Periods**
IoT Architecture - Sensor Layer - Gateway and Network Layer - Management Service Layer - Application Layer –IoT Enabling Technologies - Addressing Schemes - Data Storage and Analytics – Visualization - Connected Domains –Connected Home -Connected Worker - Connected Automobile - Connected Industry.		
UNIT – III	**IOT PLATFORMS DESIGN METHODOLOGY**	**9 Periods**
IoT Systems – Intel IoT Framework - Qualcomm IoT Framework - Microsoft IoT Framework - ARM IoT Framework -Logical Design - Programming IoT platform (eg: Python, Mono C#, Objective-C, Ruby), Raspberry Pi - Program for Firmware – Case Studies.		
UNIT – IV	**IOT STANDARDS**	**9 Periods**
Need for the IOT standards - IOT and Smart City Standards and Policies: Global perspective – Policy Research and Standardization in Europe – Indian Standards formulation – Sectional committee and composition – Challenges in standardization - Digital infrastructure.		
UNIT – V	**IOT APPLICATIONS**	**9 Periods**
Lighting as service – Smart Parking -Smart metering – Smart water management- Smart energy– Smart solid waste management - Smart mobility – Smart governance- Challenges in IoT Management.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Olivier Hersent, David Boswarthick and Omar Elloumi, "**The Internet of Things: Key Applications and Protocols**",Second Edition, Wiley Publisher, 2012.*
2	*Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, "**Architecting the Internet of Things**". Springer Science & Business Media, 2011.*

REFERENCES:

1	*Arshdeep Bahga, Vijay Madisetti, "**Internet of Things: A Hands-on Approach**", 2014.*
2	*Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.*
3	*Lu, Yan, Yan Zhang, Laurence T. Yang, HuanshengNing. "**The Internet of Things: From RFID to the Next Generation Pervasive Networked Systems**", CRC Press.*
4	*Massimo Banzi, "**Getting Started with Arduino (Make: Projects)",** O'Reilly Media. 2008*
5	*Samuel Greengard, "**The Internet of Things (The MIT Press Essential Knowledge series)",** MIT Press, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the different concepts and theories of Internet of Things.	K3
CO2	Assess the various components of IoT architecture.	K3
CO3	Perform the IoT applications in programming platform.	K3
CO4	Adopt the IoT standards for infrastructure planning.	K3
CO5	Apply the understandings of IoT in different sectors of infrastructure planning	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO2	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO3	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO4	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO5	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
22CPE $41	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO5	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40		-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	40	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	40	40	-	-	-	100
ESE	20	40	40	-	-	-	100

22CPE$40	**SUSTAINABLE INFRASTRUCTURE DEVELOPMENT**

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**PE**	**3**	**0**	**0**	**3**

Course Objective	To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation, sustainable development of infrastructure	
UNIT – I	**AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE**	**9 Periods**
Introduction to Infrastructure, an overview of the Power Sector in India., an Overview of the Water Supply and Sanitation Sector in India., an overview of the Road, Rail, Air and Port Transportation Sectors in India. , an overview of the Telecommunications Sector in India. ,an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.		
UNIT – II	**PRIVATE INVOLVEMENT IN INFRASTRUCTURE**	**9 Periods**
A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.		
UNIT – III	**CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION**	**9 Periods**
Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.		
UNIT – IV	**STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION**	**9 Periods**
Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.		
UNIT – V	**SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE**	**9 Periods**
Information Technology and Systems for Successful Infrastructure Management, Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management Infrastructure Management Systems and Future Directions.		
Contact Periods: **Lecture: 45 Periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Verma S.P. ed. "**Infrastructure in India's Development: Power, Transport and Communication**", Institute of Public Administration, New Delhi, 2004.*
2	*Dr. PravinJadhav and Dr Rahul NathChoudhury, "**Infrastructure Planning and Management in India: Opportunities and Challenges**", Springer Verlag, Singapore; 1st ed. 2022 edition.*

REFERENCES :

1	*Zimmerman, K. and F. Botelho, "**Pavement Management Trends in the United States**," 1st European Pavement Management Systems Conference, Budapest, September, 2000.*
2	*Goodman, Alvin S. and Makarand Hastak. "**Infrastructure Planning Handbook**": 2006.*
3	*Grigg, Neil, "**Infrastructure engineering and management**", Wiley, 1988.*
4	*Hudson, Haas, Uddin, "**Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation**", McGraw Hill, 1997.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Elucidate the basic concepts related to Infrastructure Projects.	K2
CO2	Interpret the role of private sector in infrastructure growth.	K1
CO3	Describe the strategies for successful Infrastructure Project implementation.	K2
CO4	Formulate Infrastructure modeling and stratagies.	K3
CO5	Summarize Sustainable development of Infrastructure.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	-	-	2	1	-	-	-	-	1	2	1	-
CO2	2	1	1	-	-	2	2	-	-	-	-	1	2	1	-
CO3	2	1	1	-	-	2	2	-	-	-	-	1	2	1	-
CO4	2	1	2	-	-	2	2	-	-	-	-	1	2	1	-
CO5	3	2	1	-	-	2	2	-	-	-	-	1	2	1	-
22CPE$42	2	1	1	-	-	2	2	-	-	-	-	1	2	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,2.1.1,2.2.2,3.1.3,6.1.1,7.1.1,12.3.1,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,3.1.3,3.1.6,6.1.1,7.1.1,7.1.2,12.3.1,12.3.2
CO3	1.1.1,1.2.1,1.3.1,2.1.1,2.1.2,2.1.3,2.2.2,3.1.3,3.1.5,3.1.6,6.1.1,7.1.1,7.1.2,12.3.1,12.3.2
CO4	1.2.1,1.3.1,2.1.1,2.1.2,2.2.2,3.1.2,3.1.3,3.1.5,3.1.6,3.3.1,6.1.1,7.1.1,7.1.2,12.3.1,12.3.2
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.2.1,2.2.2,2.4.4,3.1.3,3.1.5,3.1.6,6.1.1,7.1.1,7.1.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20				100

22CPE$41	SUSTAINABLE ENVIRONMENTAL MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To emphasize the need on sustainable development and cleaner production, create awareness on carbon trading, environmental health and safety, green process management in Industries.	
UNIT – I	**SUSTAINABLE DEVELOPMENT**	**9 Periods**
Concepts of Sustainable Development Indicators of Sustainability – Sustainability Strategies, Barriers to Sustainability – Resource Degradation – Industrialization and Sustainable Development – Socio Economic Policies for Sustainable Development.		
UNIT – II	**CLEANER PRODUCTION**	**9 Periods**
Clean Development Mechanism – Principles and Concepts of Cleaner Production – Definition Importance, Historical Evolution, Benefits, Promotion, Barriers, Source Reduction Techniques – Process and Equipment Optimization – Reuse, Recovery, Recycle, Raw Material Substitution.		
UNIT – III	**CARBON TRADING**	**9 Periods**
Green House Gases and Carbon Credit – Carbon Sequestration – Sustainable Development through Trade – Carbon Trading – Carbon footprint.		
UNIT – IV	**ENVIRONMENTAL HEALTH AND SAFETY**	**9 Periods**
Eco toxicology – Hazards by Industry and its Environmental Effects – Relationship of Occupational Hygiene / Safety and Disease – Overview, Planning, Hazard Identification and Risk Assessment – Pesticides and Environment.		
UNIT – V	**GREEN PROCESS MANAGEMENT**	**9 Periods**
Green Energy and Green Process Management in Construction, Cement, Iron and Steel Industries – Waste Audit in Industries.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Prasad Modak, "**Environmental Management towards Sustainability**", CRC Press, 2017*
2	***"Safety, Health, and Environment"**,NAPTA, 2nd Edition, Pearson Publications, 2019.*

REFERENCES :

1	*John Blewitt, "**Understanding Sustainable Development**", Third edition, Taylor & Francis Ltd., 2017.*
2	*Francisco Jose Gomes da Silva ,"**Cleaner Production: Toward a Better Future**", Ronny Miguel Gouveia , Springer Publications, 2020.*
3	*Jan Recker, Stefan Seidel, **"Green Business Process Management",** Springer Publications, 2012*
4	*Subramanian Senthilkannan Muthu,"**The Carbon Footprint Handbook** "Taylor & Francis Ltd., 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Implement the sustainable development through various strategies.	K2
CO2	Execute various practices of cleaner production.	K2
CO3	Evaluate carbon footprint to achieve sustainable development.	K3
CO4	Examine the toxicological and hazardous effects of Industries on Environment.	K2
CO5	Apply green process management in various industrial sectors.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	3	3	-	-	-	-	1	2	1	-
CO2	3	2	1	-	1	3	3	-	-	-	-	1	2	1	-
CO3	3	2	1	-	1	3	3	-	-	-	-	1	2	1	-
CO4	2	2	1	-	1	3	3	-	-	-	-	1	2	1	-
CO5	3	2	1	-	1	3	3	-	-	-	-	1	2	1	-
22CPE$43	2	2	1	-	1	3	3	-	-	-	-	1	2	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.2.2,2.2.3,2.2.4,2.3.1,3.1.1,3.1.5,3.1.6,5.1.1,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.3.1,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,3.1.1,3.1.5,3.1.6,5.1.1,5.1.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.3.1,12.3.2
CO3	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,3.1.1,3.1.5,3.1.6,5.1.1,5.1.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.3.1,12.3.2
CO4	1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,3.1.1,3.1.5,3.1.6,5.1.1,5.1.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.3.1,12.3.2
CO5	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,3.1.1,3.1.5,3.1.6,5.1.1,5.1.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$42	MATERIALS FOR ENERGY SUSTAINABILITY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To acquire the knowledge on sustainable materials, energy consumption and utility of energy for the construction of green building.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Unsustainable use of materials Global warming Green building – Concept and necessity Merits and demerits – Classification Renewable energy in buildings Basic concepts and efficiency.		
UNIT – II	**SUSTAINABLE MATERIALS**	**9 Periods**
Sustainability Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials – Handling non process waste – Waste reduction during construction – Materials with recycled waste Concept of carbon emission and its reduction		
UNIT – III	**SELECTION OF MATRIALS**	**9 Periods**
Wood Water Aggregates Raw materials Embodied energy of materials incorporation of pollutants and recycled materials alternative technologies in construction.		
UNIT – IV	**ENERGY CONSUMPTION**	**9 Periods**
Role of energy in our lives – various sources of energy –Renewable and Non renewable energy difference, characteristics of resources, advantages and disadvantages – units of energy – small and large units of energy – magnitude of energy units – units for energy consumption of individual, institution and country.		
UNIT – V	**UTILITY OF ENERGY IN BUILDINGS**	**9 Periods**
Concept Solar passive cooling techniques – Solar passive heating techniques – Low energy cooling techniques– Thermal comfort – Day lighting – Ventilation – Case studies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Ankur Mathur, **"Non Conventional Sources of Energy"**, Laxmi Publications Pvt. Ltd., 2015*
2	*Godfrey Boyle, **"Renewable Energy, Power for a Sustainable Future",** Oxford University Press, U.K., 3rd Revised Edition 2012*

REFERENCES:

1	*Tester J. W. (et al.) (2012); **"Sustainable Energy: Choosing among Options",** Second Edition, The MIT Press*
2	*Wright, R.T., and Nebel, B.J., **"Environmental Science Toward a Sustainable Future",** Prentice Hall of India Private Limited, New Delhi, 2002.*
3	*Jagadish, K.S., Venkatarama Reddy, B.V., NanjundaRao, K.S., **"Alternative Building Materials and Technologies"**, New Age International (P) Limited, 2007.*
4	*Subramanian Senthilkannan,**"Handbook of Sustainability in Additive Manufacturing",** Springer, 2016.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the aspects of unsustainable materials.	K2
CO2	Plan buildings using various sustainable materials.	K2
CO3	Apply the concepts on selection of materials.	K2
CO4	Explain the concept of energy consumption in a building.	K2
CO5	Apply the concept of energy usage with the help of solar energy in buildings	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1
CO2	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1
CO3	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1
CO4	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1
CO5	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1
22CPE$44	2	1	1	-	-	2	2	-	-	-	-	-	3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.1.1, 7.1.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.1.1, 7.1.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.1.1, 7.1.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.1.1, 7.1.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.1.1, 7.1.2.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$43	GREEN TECHNOLOGY

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objective	To provide basic knowledge on green technology, Cleaner development mechanisms, various energy efficient systems and green buildings.	
UNIT – I	**INTRODUCTION TO GREEN TECHNOLOGY**	**9 Periods**
Definition of Green Technology and its importance, History and evolution of green technology, advantages and disadvantages of green technologies, factors affecting green technologies, Role of Industry, Government and Institutions, introduction to Industrial Ecology and role of Industrial ecology in green technology.		
UNIT – II	**CLEANER DEVELOPMENT TECHNOLOGIES AND LIFE CYCLE ASSESSMENT**	**9 Periods**
Sustainability Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials – Handling non process waste – Waste reduction during construction – Materials with recycled waste Concept of carbon emission and its reduction		
UNIT – III	**ENERGY EFFICIENT SYSTEMS AND PROCESSES**	**9 Periods**
Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio fuels, fuel cells working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green Production		
UNIT – IV	**ENERGY CONSUMPTION**	**9 Periods**
Definition Features and benefits, Fundamental planning decisions for energy efficient building site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.		
UNIT – V	**UTILITY OF ENERGY IN BUILDINGS**	**9 Periods**
ECBE requirement, concepts of Overall Thermal Transfer Value (OTTV), Green performance rating, requirement of Leadership in Energy and Environmental Design (LEED), Green Rating for Integrated Habitat Assessment (GRIHA) and Indian Building Council (IGBC)		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*B.H. Khan*, ***"Non conventional energy resources"***, *Tata McGraw Hill, New Delhi 2017*
2	*Paul L. Bishop*, ***"Pollution prevention –Fundamentals and Practices"***, *McGraw Hill International 2004.*

REFERENCES:

1	*Ashok Sethuraman,* ***"Practical guide to Energy conservation & Management"***,*Notion Press, Chennai,2020.*
2	*Anthony Floyd,* ***"Green Building: A Professional's Guide to Concepts, Codes and Innovation"***,*Delmar Cengage Learning,NewDelhi,2015.*
3	*New Delhi Bureau of Energy Efficiency,* ***"GRIHA Rating System"***, *TERI Publications, 2007*
4	*David Allen,* ***"Sustainable Engineering: Concepts, Design and Case studies",*** *Prentice Hall, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Outline the importance of green technologies in sustainable growth of Industry and society	K2
CO2	Explain cleaner production and treatment mechanism for pollution prevention.	K2
CO3	Design and implementation of suitable energy efficient processes.	K3
CO4	Select suitable materials for green buildings.	K2
CO5	Asses and adopt the recommendations of various building councils.	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	-	2	2	-	-	-	-	-	2	-	1
CO2	2	1	1	1	1	2	2	-	-	-	-	-	2	-	1
CO3	2	1	1	1	1	2	2	-	-	-	-	-	2	-	1
CO4	2	1	1	1	1	2	2	-	-	-	-	-	2	-	1
CO5	2	1	2	-	-	2	3	-	-	-	-	-	2	-	1
22CPE$45	2	1	1	1	1	2	2	-	-	-	-	-	2	-	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1, 1.3.1, 2.2.2, 3.1.5, 3.2.3, 6.1.1, 7.2.1, 7.1.2.
CO2	1.2.1, 1.3.1, 2.2.2, 3.1.5, 3.2.3, 4.1.1, 5.2.1, 6.1.1, 7.2.1, 7.1.2.
CO3	1.2.1, 1.3.1, 2.2.2, 3.1.5, 3.2.3, 4.1.1, 5.2.1, 6.1.1, 7.2.1, 7.1.2.
CO4	1.2.1, 1.3.1, 2.2.2, 3.1.5, 3.2.3, 4.1.1, 5.2.1, 6.1.1, 7.2.1, 7.1.2.
CO5	1.2.1, 1.3.1, 2.2.2, 3.1.4, 3.1.5, 3.2.3, 5.2.1, 6.1.1, 6.2.1, 7.2.1, 7.1.2. 7.2.2,

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22CPE$44	BUILDING INFORMATION MODELING SYSTEMS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To understand the role of BIM in construction management and to offer an advanced education programme on BIM integrated design, construction and operation processes.	
UNIT – I	**INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM)**	**9 Periods**
Background of Building Information Modelling (BIM); Components of BIM, BIM Focus, Users of BIM information and Project Delivery Methods using BIM.		
UNIT – II	**BIM IN DRAFTING**	**9 Periods**
Conceptual Design in Terms Shape, Orientation, Site in Terms of Green Strategy, Architectural BIM, Architectural Drafting, Architecture 3D Rendering.		
UNIT – III	**BIM IN STRUCTURAL DESIGN**	**9 Periods**
Structural BIM Design: Systems and Materials, Structural Rebar Detailing, Green Design Decisions. BIM Analysis: Day lighting, Energy Analysis and Energy Cost; Documentation.		
UNIT – IV	**BIM IN PLANNING AND CONSTRUCTION PHASE**	**9 Periods**
BIM In Fabrication, BIM In Construction Gate keeping, 4D BIM – Construction Scheduling, 5D – Construction Cost Estimation, Quantity Take off, Clash Detection and Construction Logistics.		
UNIT – V	**CASE STUDIES ON BIM**	**9 Periods**
Architectural BIM in Residential Buildings and 3D Rendering Services; Structural BIM Modelling for Multi Storey– Residential Building and BIM Implementation during New Construction.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45Periods**		

TEXT BOOKS:

1	*De Wilde, P., Mahdjoubi, L., &Garrigós, A. G., **"Building Information Modelling (BIM) in Design, Construction and Operations"**, WIT Press, Volume 192, 2019.*
2	*Kymmell, W., "**Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations"**, McGraw Hill Education, First Edition. 2008.*

REFERENCES:

1	*Elvin, G.,**"Integrated Practice in Architecture: Mastering Design Build, Fast Track, And Building Information Modelling"**, John Wiley & Sons, First Edition, 2007.*
2	*The BIM Manager's Handbook: **Guidance for Professionals in Architecture, Engineering, and Construction.***
3	*BIG BIM, little BIM: **The Practical Approach to Building Information Modelling**.*
4	*BIM Handbook: **A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Study the background of BIM and its role in construction management	K2
CO2	Identify the role of BIM approach in planning of building.	K2
CO3	Comprehend the role of BIM approach in design coordination to aid in decision making	K2
CO4	Apply BIM in construction design, planning and construction phases.	K2
CO5	Apply BIM for case studies	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
CO2	0	2	1	1	1	0	1	0	0	0	0	0	0	0	0
CO3	2	2	1	2	2	0	0	0	0	0	1	0	0	0	0
CO4	3	1	1	2	1	0	0	0	0	0	2	0	0	0	0
CO5	2	1	1	2	1	2	1	1	0	2	0	1	0	0	0
22CPE$46	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**1**	**1**	**1**	**-**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.4.1,2.1.3,3.1.5,3.2.1,4.1.1,4.1.2,5.1.1
CO2	2.1.1,2.1.2,2.2.3,2.3.1,2.3.2,3.1.6,4.1.1,4.1.2,4.1.3,5.1.1,7.2.2
CO3	1.3.1,1.4.1,2.1.2,2.2.1,2.2.3,2.2.4,2.4.3,2.4.4,3.1.2,3.2.1,3.2.3,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,5.1.1,5.2.1,5.3.1,11.3.2
CO4	1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.2.2,2.2.3,2.4.2,3.1.4,3.2.1,3.3.2,4.1.1,4.1.2,4.1.3,4.2.1,4.3.2,4.3.3,5.1.1,5.2.1,11.2.1,11.3.2
CO5	1.3.1,1.4.1,2.2.3,2.4.3,3.1.5,3.2.2,4.1.1,4.2.1,4.3.1,4.2.1,5.1.1,5.2.1,6.1.1,7.2.1,8.2.2,10.1.1,10.1.2,10.2.2,12.2.1,12.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$45	MODERN CONSTRUCTION EQUIPMENTS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To study and understand the various types of equipment used for earthwork, compacting, concreting, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.	
UNIT – I	**CONSTRUCTION EQUIPMENT SELECTION**	**9 Periods**
Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment Depreciation Analysis – Replacement of Equipment - Replacement Analysis – Safety Management.		
UNIT – II	**EQUIPMENT FOR EARTHWORK**	**9 Periods**
Fundamentals of Earth Work Operations Earth Moving Operations Types of Earth Work Equipment Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and Hauling Equipment, Compacting Equipment, Finishing Equipment.		
UNIT – III	**CONCRETING EQUIPMENT**	**9 Periods**
Aggregate production Different Crushers – Feeders Screening Equipment Handling Equipment Batching and Mixing Equipment Pumping Equipment – Ready Mix Concrete Equipment, Concrete Pouring Equipment.		
UNIT – IV	**MATERIALS HANDLING EQUIPMENT**	**9 Periods**
Forklifts and related equipment Portable Material Bins – Material Handling Conveyors – Material Handling Cranes Industrial Trucks – Storage Handling Equipment – Bulk Material Handling.		
UNIT – V	**OTHER CONSTRUCTION EQUIPMENT**	**9 Periods**
Equipment for Dredging, Trenching and Tunneling – Equipment for Drilling and Blasting Pile Driving Equipment - Erection Equipment - Equipment for Dewatering and Grouting – Equipment for Demolition Types of pumps used in Construction.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods**		

TEXT BOOKS:

1	*Peurifoy, R.L., Schexnayder, C. and AviadShapira.,* ***"Construction Planning, Equipment and Methods"****, McGraw Hill Education , 2018.*
2	*Deodhar, S.V.,* ***"Construction Equipment and Job Planning",*** *Khanna Publishers,2012.*

REFERENCES:

1	*Leonhard E. Bernold,* ***"Construction Equipment and Methods: Planning, Innovation, Safety",*** *2015.*
2	*Sharma S.C. Khanna Publishers, "****Construction Equipment and Management",*** *New Delhi, 2019.*
3	*GranbergG.,Popescu M Taylor and Francis Publishers,****"Construction Equipment and Management for Engineers Estimators and Owners",*** *New York, 2006.*
4	*Dr.MaheshvarmaMetropolitian book company,* ***"Construction equipment and its planning and application",*** *New Delhi 1988.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Develop knowledge on the planning and selection of equipment.	K2
CO2	Explain the knowledge on fundamentals and working operations of earth work equipment.	K2
CO3	Develop the knowledge on concreting equipment.	K2
CO4	Apply the knowledge on material handling equipment techniques.	K2
CO5	Select suitable construction equipment for different construction activities.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1	1	-	-	2	-	-	-	-	-	-	-
CO2	2	2	1	1	1	-	1	-	-	-	-	1	-	-	-
CO3	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	2	1	1	-	1	1	-	-	-	-	-	-	-
CO5	2	1	2	2	2	-	-	1	-	2	2	1	-	-	-
22CPE$47	**2**	**1**	**1**	**1**	**1**	**-**	**1**	**2**	**-**	**1**	**1**	**1**	**-**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping	
CO1	1.2.1,1.3.1,2.1.3,2.2.1,2.2.3,3.1.5,4.1.1,4.1.2,5.1.1,8.1.1,8.2.1
CO2	1.2.1,1.3.1,2.1.1,2.1.2,2.2.3,2.3.1,2.3.2,3.1.5,3.1.6,3.2.1,3.4.2,4.1.1,4.1.3,5.1.1,5.3.1,7.1.1,12.2.1
CO3	1.4.1,2.1.2,2.2.1,2.2.3,2.2.4,2.4.3,2.4.4,3.1.2,3.1.5,3.1.6,4.1.3,4.1.4,4.2.1,5.1.1
CO4	1.2.1,1.3.1,2.1.2,2.2.2,2.2.3,2.4.2,3.1.4,3.1.5,3.1.6,3.2.1,3.2.3,3.3.1,4.1.3,4.2.1,4.3.1,5.1.1,7.2.2,8.2.2
CO5	1.3.1,1.4.1,2.2.3,2.4.3,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,4.1.1,4.1.2,4.1.3,4.2.1,5.1.1,5.1.2,5.2.1, 8.2.2,10.1.1,10.1.2,10.2.2,11.2.1,11.3.2,12.2.1,12.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20			-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	40	40	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	40	40	20	-	-	-	100
ESE	40	40	20	-	-	-	100

22CPE$47	**ROAD SAFETY ENGINEERING**	
PREREQUISITES		**L T P C**
		3 0 0 3

Course Objective:	To develop knowledge and skills in road safety analysis, crash investigation, and mitigation planning to improve transportation safety through sustainable and data-driven engineering solutions.	
Unit – I	**INTRODUCTION TO ROAD SAFETY**	**9 Periods**
Road accidents – Trends – Crash causation – Collision diagrams – Highway safety – Human factors and road user limitations – Speed and its effect on road safety – Vehicle factors – Highway safety in India – Multi casual dynamic systems approach to safety – Crash Vs Accidents – Road safety improvement strategies – Elements of road safety plan, Safety data needs – Safe vehicle design.		
Unit – II	**STATISTICAL INTERPRETATION AND ANALYSIS OF CRASH DATA**	**9 Periods**
Before-after methods in crash analysis – Recording of crash data – Accident investigation techniques – Statistical testing and the role of chance – Black Spot Identification and Investigations – Case studies.		
Unit – III	**ROAD SAFETY AUDITS**	**9 Periods**
Key elements of a road safety audit – Road safety audits(RSA): Procedures, checklists and case studies & investigations – Work zone safety audit – Crash investigation and analysis – Methods for identifying hazardous road locations.		
Unit – IV	**CRASH RECONSTRUCTION**	**9 Periods**
Information on roadway surface – Basic physics of crash reconstruction – Speed for various skid, friction, drag, and acceleration scenarios – Jump and flip crashes – Pedestrian crashes – Case studies.		
Unit – V	**MITIGATION MEASURES**	**9 Periods**
Mitigation measures – Accident prevention by planning and design of roads – Crash counter measures – Highway operation and accident control measures – Highway safety measures during construction – Safety in urban areas – Public transport and safety – Road safety policy-making – Stakeholders involvement – Road safety law.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXTBOOKS:

1.	*Traffic Engineering and Transport Planning* by Kadiyali L.R, Khanna Publishers, Delhi, 2020.
2.	*Transportation Engineering* by Khisty C.J. and Kent B. Lall, Prentice Hall, 2018.

REFERENCES:

1.	*Road Safety Inspections and Audits* by Rune Elvik, 2022.
2.	*Human Factors in Road Safety* by Jens Rasmussen, Kinga M. Wisniewski, and Rune Elvik, 2020.
3.	*Statistical Methods for Road Safety Analysis* by W.C. Mannering and Kenneth L. Caves, 2019.
4.	*Handbook of Transportation Safety* by Robert J. Haver, 2019.
5.	*Road Safety: An Introduction* by David Jamieson, 2020.

COURSE OUTCOMES: Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Explain the fundamental concepts of road safety, crash causation factors, and the human, vehicular, and environmental influences on highway safety.	K2
CO2	Apply statistical techniques to interpret crash data and conduct accident investigations for identifying black spots and crash patterns.	K3
CO3	Conduct road safety audits, and assess safety performance in work zones and hazardous locations.	K3
CO4	Analyze crash scenarios using principles of physics and crash reconstruction methods to estimate vehicle speed.	K3
CO5	Evaluate and propose appropriate mitigation and countermeasures for accident prevention, considering planning, design, and policy frameworks.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

CO's / PO's	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**	**PS O4**
CO1	3	2				2	1					1	2	2	2	
CO2	3	3		3										3	2	
CO3	2	2	3	3		2	2						2	2	3	
CO4	2	3		3										2	2	
CO5	2	3	3	2		3	3					1	2	2	3	
22CPE $48	3	3	3	3		3	3					1	2	3	3	

1 Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 6.2.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 6.2.1
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 4.1.1, 4.1.2, 4.1.3, 4.1.4
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.4.1, 2.4.2, 2.4.3, 3.1.1, 3.1.5, 3.1.6, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 6.2.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

<table>
<tr><td>22COE$01</td><td colspan="6">DISASTER MANAGEMENT AND MITIGATION
(Common to All Branches)</td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>CATEGORY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">NIL</td><td>OE</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Objective</td><td colspan="6">To impart knowledge to create appropriate planning, preparation and response for emergency treatment in disaster situation</td></tr>
<tr><td>UNIT – I</td><td colspan="2">INTRODUCTION TO DISASTERS</td><td colspan="4">9 Periods</td></tr>
<tr><td colspan="7">Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Classification, Causes, Impacts - Global Trends in Disasters: Urban Disasters, Pandemics, Complex Emergencies, Climate Change- Dos and Don’ts during various types of Disasters.</td></tr>
<tr><td>UNIT – II</td><td colspan="2">HAZARDS AND RISK VULNERABILITY</td><td colspan="4">9 Periods</td></tr>
<tr><td colspan="7">Hazard Identification and Hazard Profiling - Hazard Analysis - Types of hazards - Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – Purpose, Risk Acceptability, Alternatives, Personnel. Political/ Social, Economic. Vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile - Factors Influencing Vulnerability, Risk Perception.</td></tr>
<tr><td>UNIT – III</td><td colspan="2">MITIGATION AND PREPAREDNESS</td><td colspan="4">9 Periods</td></tr>
<tr><td colspan="7">Mitigation - Types, Obstacles, Assessment and Selection of Mitigation options, Emergency Response capacity, Incorporating Mitigation into Development and Relief Projects. Preparedness- Government Preparedness, Public Preparedness, Media as a Public educator. Obstacles to public education and preparedness.</td></tr>
<tr><td>UNIT – IV</td><td colspan="2">RESPONSE AND RECOVERY</td><td colspan="4">9 Periods</td></tr>
<tr><td colspan="7">Response the Emergency- Pre disaster, post disaster, Provision of Water, Food and Shelter, Volunteer Management, Command, Control and Coordination. Recovery- Short Term and Long-term Recovery- Components of Recovery- Planning, Coordination, Information, Money and Supplies, Allocation of Relief Funds, Personnel. Types of Recovery- Government, Infrastructure, Debris Removal Disposal and Processing, Environment, Housing, Economic and Livelihood, Individual, Family and Social Recovery- Special Considerations in Recovery.</td></tr>
<tr><td>UNIT – V</td><td colspan="2">DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES</td><td colspan="4">9 Periods</td></tr>
<tr><td colspan="7">Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.</td></tr>
<tr><td colspan="7">Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods</td></tr>
</table>

TEXT BOOKS :

1	*Singhal J.P.* ***“Disaster Management”,*** *Laxmi Publications, 2010.*
2	*Tushar Bhattacharya,* ***“Disaster Science and Management”,*** *McGraw Hill India Education Pvt. Ltd., 2012.*

REFERENCES:

1	*Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.*
2	*Government of India, National Disaster Management Policy,2009 Periods.*
3	*Gupta Anil K, Sreeja S. Nair.* ***“Environmental Knowledge for Disaster Risk Management”,*** *NIDM, New Delhi, 2011*
4	*Kapur Anu Vulnerable India:* ***A Geographical Study of Disasters****, IIAS and Sage Publishers, New Delhi, 2010*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the types of disasters, causes and their impact on environment and society	K2
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.	K2
CO3	Comprehend the mitigation and preparedness process.	K2
CO4	Describe about response and recovery process during disaster.	K2
CO5	Perform disaster damage assessment and management.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO2	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO3	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO4	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
CO5	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2
22COE$01	1	-	1	-	2	3	3	2	2	2	-	3	2	-	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9 .2.1, 10.1.1, 10.1.2, 10.1.3
CO2	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, **7.2.2,** 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9 .2.1, 10.1.1, 10.1.2, 10.1.3
CO3	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO4	1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3
CO5	1.2.1, 3.3.6, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9 .1.1, 9.1.2, .2.1, 10.1.1, 10.1.2, 10.1.3

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22COE$02	**WATER SANITATION AND HEALTH** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand the overview of Environment, Health and Safety (EHS) in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System	
UNIT – I	**INTRODUCTION**	**9 Periods**
Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of Trade Union Safety Representatives – Ergonomics.		
UNIT – II	**OCCUPATIONAL HEALTH AND HYGIENE**	**9 Periods**
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 Periods**
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 Periods**
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 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	***Industrial Health and Safety Acts and Amendments****, by Ministry of Labour and Employment, Government of India.*
2	*Dr.K.U.Mistry, Siddharth Prakashan,* ***"Fundamentals of Industrial Safety and Health"****, 2012*

REFERENCES:

1	*Bill Taylor,* ***"Effective Environmental, Health, and Safety Management Using the Team Approach",*** *Culinary and Hospitality Industry Publications Services, 2005.*
2	*Nicholas P.Cheremisinoff and Madelyn L. Graffia,* ***"Environmental and Health and Safety Management"****, William Andrew Inc. NY, 1995.*
3	*Brian Gallant,* ***"The Facility Manager's Guide to Environmental Health and Safety"*** *, Government Inst Publ., 2007.*
4	*https://archive.nptel.ac.in/courses/114/106/114106017/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Outline the needs for EHS in industries and related Indian regulations	K2
CO2	Assess the various types of Health hazards, effect, assessment and control methods	K2
CO3	Identity the various safety systems in working environments	K2
CO4	Select the methodology for preparation of Emergency Plans and Accident investigation	K3
CO5	Describe the EHS Management System and its elements	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO2	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO3	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO4	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-
CO5	2	-	1	-	2	3	3	2	1	-	2	-	1	1	-
22COE$02	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO2	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO3	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO4	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.
CO5	1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1.

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	25	50	25	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	25	50	25	-	-	100
ESE	30	30	40	-	-	-	100

22MOE$03	**NANOTECHNOLOGY AND SURFACE ENGINEERING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objectives	To educate the production techniques and characterization techniques of nano materials and to familiarize about the surface modification techniques using nano materials.	
UNIT – I	**ELEMENTS OF NANO-SCIENCE AND NANOTECHNOLOGY**	**9 Periods**
Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.		
UNIT – II	**NANOTECHNOLOGY AND CERAMICS**	**9 Periods**
Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods		
UNIT – III	**CHARACTERIZATION OF NANOMATERIALS**	**9 Periods**
X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV / Visible Spectroscopy.		
UNIT – IV	**SURFACE ENGINEERING**	**9 Periods**
Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.		
UNIT – V	**SURFACE MODIFICATION TECHNIQUES**	**9 Periods**
Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*G. Cao, **"Nanostructures and Nanomaterials: Synthesis",** Properties and Applications by Imperial College Press, 2nd edition, 2011.*
2	*Keith Austin "**Surface Engineering Hand Book"**, London : Kogan Page, 1998*

REFERENCES:

1	*Gregory Timp, "**Nanotechnology",** Springer, 2012*
2	*Dheerendra Kumar Dwivedi, **"Surface Engineering: Enhancing Life of Tribological Components"**, Springer, 2018*
3	*D. Phil Woodruff,**"Modern Techniques of Surface Science**", Cambridge University Press, 2016*
4	*Sulabha K. Kulkarni ,**"Nanotechnology: Principles and Practices**", Springer, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Choose appropriate nano material and its manufacturing method.	K1
CO2	Select most suitable technique to deposit a layer of nano material on ceramic surface.	K2
CO3	Identify appropriate techniques to characterize nano materials.	K2
CO4	Select surface preparation, coating techniques and predict their combinational effect for engineering applications.	K2
CO5	Adopt different techniques to modify surfaces and make surface composites as per requirement.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO2	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO3	-	1	2	1	1	-	-	-	-	-	-	-	2	2	3
CO4	-	2	2	1	1	-	-	-	-	-	1	-	2	3	3
CO5	-	1	2	1	1	-	-	-	-	-	1	-	3	2	3
22MOE$03	-	1	2	1	1	-	-	-	-	-	1	-	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2
CO2	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2
CO3	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2
CO4	2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1
CO5	2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50	-	-	-	-	100
CAT2	30	70	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

22MOE$04	**INDUSTRIAL SAFETY MANAGEMENT** *(Common to All Branches)*

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objectives	To learn the techniques of industrial safety and management to implement and solve safety problems in engineering.	
UNIT – I	**ENVIRONMENT AND SAFETY PHILOSOPHY**	**9 Periods**
Henrichs Axioms Of Industrial Safety - Concepts Of Safety – Ethics of environmental conservation – Environmental Impact Assessment – Environmental economics – Safety philosophy – Planning for safety – Organising for safety – Directing for safety - Role of Occupier and Factory Manager, Factory Safety Committee, Structure and Functions and Working Tenure Details		
UNIT – II	**SAFETY APPRAISAL AND CONTROL TECHNIQUES**	**9 Periods**
Plant and equipment safety appraisal techniques – Laws and regulation – Hazards and Risks – Major accident hazard control – Importance of Disaster management		
UNIT – III	**ACCIDENT PREVENTION AND SAFETY MANAGEMENT**	**9 Periods**
Incident - Accident - Injury - Dangerous occurrence - Unsafe Act - Unsafe Conditions - Hazards - Error, Oversight - Mistake , Near Miss - Measurement of safety performance - Key elements of Safety Management system (ISO 14001, OHSAS 18001 etc.). ILO Legislations – Convention and Recommendation concerning Safety, Health and Environment – Objectives of Health, Safety and Environment Policy, Responsibility for Implementation of HSE Policy.		
UNIT – IV	**SAFETY MANAGEMENT IN INDUSTRIES**	**9 Periods**
Safe Guarding of machines – Manual handling and storage of materials – Mechanical handling of materials – Hand tools and portable power tools – Electrical hazards – Earth , insulation and continuity tests – Industrial lighting – Safety of pressure vessels – Ventilation and heat control – Housekeeping – Special precautions - Safety in Construction Industry – Safety in Engineering Industry – Safety in Chemical Industries – Safety in Textile Industries – Safety in Dock and Port – Transportation Safety – Safety in Fire and explosive industries.		
UNIT – V	**INDUSTRIAL HYGIENE AND POLLUTION CONTROL**	**9 Periods**
Industrial Hygiene – Air sampling – Noise and vibration – Industrial physiology - Occupational health – Personal Protective Equipment's – Pollution Control strategies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Akhil Kumar Das, **"Principles of Industrial Safety Management":Understanding the Ws of Safety at Work"** PHI Learning , 2021*
2	*Jain R K and Sunil.S.Rao, **"Industrial Safety Health and Environment Management System"**, Seventh reprint, Khanna publishers, 2023.*

REFERENCES:

1	*Prathibha Bansal and Anupama Prashar, **"Industrial safety and Environment"**, S.K.Kattaria Sons, 2005.*
2	*A.K.Gupta, **"Industrial safety and Environment"**, Laxmi Publication Pvt Limited, 2008.*
3	***"Accident Prevention Manual For Industrial Operations"**, N.S.C Chicago, 13th Edition 2009.*
4	*Dan Petersen, **"Techniques of Safety Management"**, Americal Society of Safety Emgineers, 4th edition, 2003.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand Environment and safety philosophy.	K1
CO2	Frame Safety appraisal and control technique to create safety management.	K2
CO3	Follow accident prevention procedure to solve safety problem.	K2
CO4	Implement safety management for Industries.	K3
CO5	Follow Industrial Hygiene and Pollution control	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
CO4	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
22MOE$04	3	3	-	1	3	-	-	-	-	-	-	-	3	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.4.4, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2
CO2	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO3	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO4	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2
CO5	1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2

ASSESSMENT PATTERN

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	70	20	10	-	-	-	100
CAT2	50	30	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	60	40	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	30	20	-	-	-	100
ESE	50	30	20	-	-	-	100

22EOE$05	RENEWABLE POWER GENERATION SYSTEMS *(Common to All Branches)*					
PREREQUISITES		**CATEGORY**	**L**	**T**	**P**	**C**
NIL		OE	3	0	0	3
Course Objectives	To understand energy scenarios, energy sources and their utilization, society's present needs and future energy demands, the principles of renewable energy conversion systems					
UNIT – I	**ENERGY SCENARIO**					**9 Periods**
Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).						
UNIT – II	**SOLAR ENERGY**					**9 Periods**
Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.						
UNIT – III	**WIND AND BIOMASS ENERGY**					**9 Periods**
Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi blade system. Vertical axis- Savonius and Darrieus types. Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft).						
UNIT – IV	**TIDAL AND OCEAN THERMAL ENERGY**					**9 Periods**
Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.						
UNIT – V	**GREEN ENERGY**					**9 Periods**
Introduction, Fuel cells: Classification of fuel cells – H_2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.						
Contact Periods: (Times New Roman, Size 11, BOLD, Sentence case) **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**						

TEXT BOOK (Maximum 2):

1	G D Rai, Non Conventional Energy sources, Khanna Publication, Fourth Edition, 2009
2	Boyle, "Renewable Energy – Power For A Sustainable Future", Oxford, 2012

REFERENCES (Minimum 4 and Maximum 6):

1	S Rao,B.B.Parulekhar, "Energy Technology 3/e: Nonconventional, Renewable and Conventional", Khanna Publishers, 1994
2	G. N. Tiwari,"Solar Energy - Fundamentals, Design, Modelling and Applications", 2002
3	Gilbert M. Masters, "Renewable and Efficient Electric Power Systems" Wiley,2005
4	Shobh Nath Singh, "Non-Convention Energy Resources", Pearson, 2018

Note: Books with 10 years before publications may be avoided

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	K2
CO2	Summarize the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, electric power generation.	K2
CO3	Apply the conversion principles of wind and tidal energy for the production of electric power generation	K3
CO4	Apply the concept of biomass energy resources and green energy for developing sustainable electric power generation set-up	K3
CO5	Analyze the basic knowledge of ocean thermal energy conversion and hydrogen energy and hence design & evaluate the power generation system	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO2	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO4	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
CO5	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
22EOE$05	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2.

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)							
Test / Bloom's Category*	**Rememberi ng (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	20	30	30	-	-	100
CAT2	20	20	30	30	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	30	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	30	30	-	-	100
ESE	20	20	30	30	-	-	100

22EOE$06	**SMART GRID TECHNOLOGY** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To provide a comprehensive understanding of Smart Grid Technology, including its components, functions, applications and implications for Energy Management and Distribution.	
UNIT – I	**BASICS OF POWER SYSTEMS**	**9 Periods**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry-Standardization		
UNIT – II	**SMART GRID COMMUNICATIONS**	**9 Periods**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure		
UNIT – III	**WIDE AREA MEASUREMENT**	**9 Periods**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges		
UNIT – IV	**SECURITY AND PRIVACY**	**9 Periods**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks-Defense Mechanisms - Privacy Challenges- Cyber Security Standards		
UNIT – V	**ECONOMICS AND MARKET OPERATIONS**	**9 Periods**
Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices- Financial Transmission Rights		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage* "**Smart Grid Technologies and applications**" *John Wiley Publishers Ltd., 2012.*
2	*P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan* "**Electrical Power Systems-Analysis, Security and Deregulation**" *PHI Learning Private Limited, New Delhi, 2012.*

REFERENCES

1	*Lars T. Berger, Krzysztof Iniewski* "**Smart Grid applications, Communications and Security**" *John Wiley Publishers Ltd., 2012.*
2	*Yang Xiao,* "**Communication and Networking in Smart Grids**", *CRC Press Taylor and Francis Group, 2012.*
3	*Caitlin G. Elsworth,* "**The Smart Grid and Electric Power Transmission**", *Nova Science Publishers Inc, August 2010*
4	*Lars T. Berger, Krzysztof Iniewski* "**Smart Grid applications, Communications and Security**" *John Wiley Publishers Ltd., 2012.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Recollect the fundamentals of conventional power systems and learn the concept of smart grid	K1
CO2	Interpret the role of communication Technologies in a smart grid	K2
CO3	Apply the state-of-the-art measurement and protection techniques for reliable grid	K3
CO4	Utilize the techniques for ensuring safety and security of the smart grid	K3
CO5	Analyze the economical aspects of the smart grids	K4

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	2	2	-	-	1	1	-	3	2	1
CO2	3	3	1	2	2	-	-	-	-	2	3	2	3	2	1
CO3	3	3	1	2	2	-	-	-	-	2	3	2	3	3	2
CO4	3	3	1	2	2	3	2	2	1	-	-	3	3	3	2
CO5	3	2	2	2	2	-	2	2	-	1	3	3	3	3	2
22EOE $06	3	3	1	2	2	3	2	2	1	2	3	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.3.1,2.3.2,2.4.4,3.1.3,3.1.6,3.2.1,4.1.4,4.2.1,4.3.4,5.1.1,5.3.1,6.1.1,7.1.1,7.2.2,10.1.1,10.3.1,11.1.1
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,8.2.2,9.1.2,7.2.1,7.2.2,6.2.1,6.1.1,5.3.2,5.3.1,5.3.212.1.2,12.2.2,12.3.2,
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	10	30	40	20	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	30	30	20	20	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	30	30	20	20	-	100
ESE	10	30	40	20	-	-	100

22LOE$07	**CMOS VLSIDESIGN** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components	
UNIT – I	**CMOSLOGICDESIGN**	**9 Periods**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates –Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Designrule–GateLayouts–StickDiagrams–DesignPartitioning.		
UNIT – II	**MOSTRANSISTORTHEORY**	**9 Periods**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects –DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - DynamicPower–Static Power.		
UNIT – III	**COMBINATIONALCIRCUITDESIGN**	**9 Periods**
CircuitFamilies:StaticCMOS–RatioedCircuits–CascodeVoltageSwitchLogic–Dynamic Circuits–PassTransistorCircuits.Silicon-on-InsulatorCircuitDesign–SubthresholdCirucitDesign.		
UNIT – IV	**SEQUENTIALCIRCUITDESIGN**	**9 Periods**
Sequentialstaticcircuits–Circuitdesignoflatchedandflip-flops–Sequencingdynamiccircuits –Synchronizers–Wavepipelining -VLSIclocking:CMOS clockingstyles-Pipelinedsystems-Clockgenerationanddistribution.		
UNIT – V	**DESIGNOFVLSISYSTEMS**	**9 Periods**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – BehavioralandRTL Modeling-Addition/subtraction–Comparators–counters—Multiplexers-BinaryDecoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM –DRAM–ROM.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, PearsonEducation,2011*
2	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCES:

1	*JanM.Rabaey,"**DigitalIntegratedCircuits:ADesignPerspective**",PHI,SecondEdition,2012.*
2	*R.JacobBaker,"**CMOS:CircuitDesign,Layout,andSimulation**",Wiley-IEEE,RevisedSecondEdition,2008.*
3	*Pucknell,"**BasicVLSIDesign**",PrenticeHall,2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Realize the CMOS logic design	K2
CO2	Explain the basic MOS transistor theory and power dissipation in CMOS logic.	K2
CO3	Develop combinational circuit design of CMOS logic	K3
CO4	Interpret sequential circuit design of CMOS logic	K2
CO5	Model the digital system using Hardware Description Language	K2

COURSE ARTICULATION MATRIX :

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO2	3	2	1	-	-	2	-	-	-	2	-	3	2	1	2
CO3	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO4	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
CO5	3	3	2	-	-	2	-	-	-	2	-	3	3	1	3
22LOE$07	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**3**	**3**	**1**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	40	20	-	-	-	100
CAT2	40	40	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	40	40	20	-	-	-	100

22LOE$08	**MOBILE COMMUNICATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand and recall the mobile radio propagation, cellular architectures, equalization and diversity techniques, digital modulation techniques and various wireless network standards.	
UNIT – I	**MOBILE RADIO PROPAGATION**	**9 Periods**
Review of free-space propagation - Radio Wave Propagation in wireless environment - Free Space Propagation Model - Ground Reflection Model, Diffraction, Scattering - Practical link budget design - Small scale fading - Time dispersion parameters - Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - Fading due to Doppler spread.		
UNIT – II	**CELLULAR CONCEPT**	**9 Periods**
Hexagonal cell-Cell clustering-Frequency Reuse-Static and dynamic channel assignment strategies - Handoff Strategies - Interference and System Capacity - Trunking - Capacity in Cellular Systems. Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA.		
UNIT – III	**MULTIPATH MITIGATION TECHNIQUES**	**9 Periods**
Equalization – Adaptive equalization: Linear and Non-Linear equalization, - Diversity – Micro and Macro diversity - Diversity combining techniques - Rake receiver- MIMO Coding: Alamouti Scheme (Qualitative)		
UNIT – IV	**MODULATION TECHNIQUES**	**9 Periods**
Modulation in cellular wireless systems: Binary Phase Shift Keying (BPSK) – QPSK –Orthogonal QPSK-Minimum Shift Keying-Gaussian Minimum Shift Keying - Multicarrier modulation: Orthogonal Frequency Division Multiplexing (OFDM) -PAPR reduction –Windowed OFDM - Filtered OFDM		
UNIT – V	**WIRELESS NETWORKS**	**9 Periods**
Second Generation Cellular Standard: GSM - Third Generation Cellular standards: CDMA -WCDMA-Fourth Generation Cellular Standards: 4G LTE – LTE Advanced – 5G Network – Near Field Communication (NFC) systems – Wireless LAN technology – Hyper LAN – Bluetooth technology – Ultra Wideband (UWB) communication - Introduction to 60 GHz mmWave.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS:

1	*Theodore S. Rappaport, "Wireless communications", 2nd Edition, Pearson Education, 2010*
2	*Mischa Schwartz, "Mobile Wireless Communications", 1st Edition, Cambridge University Press, 2010*

REFERENCES:

1	*Suvra Sekhar Das and Ramjee Prasad, "Evolution of air interface towards 5G Radio Access Technology and Performance Analysis", River Publishers,2018*
2	*David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", 1st Edition, Cambridge University Press, 2006.*
3	*Andreas.F. Molisch, "Wireless Communications", 2nd Edition, Wiley, 2011.*
4	*Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", 1st Edition, McGraw Hill Education (India) Private Limited, 2017*
5	*William Stallings, "Wireless Communications and networks", 2nd Edition, Pearson, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Interpret the concepts of radio propagation and fading channel models in wireless communication	K3
CO2	Interpret the functionalities of various cellular concepts and multiple access techniques and solve problems in channel assignment and traffic intensity in cellular system	K4
CO3	Explain various equalization and diversity combining techniques used in multipath propagation	K2
CO4	Discuss the need for digital and multicarrier modulation techniques used in modern cellular system	K2
CO5	Recall the functionalities of various wireless networks used in day-today life.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
CO5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
22LOE$08	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2
CO4	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2
CO5	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	20	40	20	20	-	-	100
CAT2	50	50			-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	40	20	20	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	20	40	20	20	-	-	100

22POE$09	**RAPIDPROTOTYPING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To educate the students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and associated Aerospace, Architecture, Art, Medical and Industrial applications.	
UNIT- I	**INTRODUCTION**	**9 Periods**
Overview - Need - Development of Rapid Prototyping (RP) Technology: Rapid Prototyping -Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. RP Process Chain, Benefits, Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare.		
UNIT- II	**VAT POLYMERIZATION AND MATERIAL EXTRUSION**	**9 Periods**
Photo polymerization: Stereo lithography Apparatus (SLA) - Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modelling (FDM) - Process-Materials -Applications and Limitations.		
UNIT- III	**POWDER BED FUSION AND BINDER JETTING**	**9 Periods**
Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications.		
UNIT- IV	**MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION**	**9 Periods**
Material Jetting: Multi jet Modelling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery -Materials –Benefits - Applications.		
UNIT- V	**SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY**	**9 Periods**
Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "**Additive manufacturing technologies".** 3rd edition Springer Cham, Switzerland, 2021.*
2	*Andreas Gebhardt and Jan-Steffen Hötter "**Additive Manufacturing: 3D Printing for Prototyping and Manufacturing**", Hanser publications, United States, 2015.*

REFERENCES:

1	*Andreas Gebhardt, **"Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing"**, Hanser Gardner Publication, Cincinnati., Ohio, 2011.*
2	*Milan Brandt, **"Laser Additive Manufacturing: Materials, Design, Technologies, and Applications"**, Woodhead Publishing., United Kingdom, 2016.*
3	*Amit Bandyopadhyay and Susmita Bose, **"Additive Manufacturing",** 1st Edition, CRC Press., United States, 2015.*
4	*Kamrani A.K. and Nasr E.A., **"Rapid Prototyping: Theory and practice",** Springer., United States ,2006.*
5	*Liou, L.W. and Liou, F.W., **"Rapid Prototyping and Engineering applications: A tool box for prototype development"**, CRC Press., United States, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Discuss the development of RP technology and how RP technology propagated into various businesses and developing opportunities.	K3
CO2	Demonstrate the Vat polymerization and material extrusion processes and its applications.	K3
CO3	Elaborate the process and applications of powder bed fusion and binder jetting.	K3
CO4	Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.	K3
CO5	Describe the sheet lamination and direct write technology.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	-	2	-	3	-	3	3	3	3	-	-	-
CO2	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO3	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO4	2	2	3	2	3	-	3	-	3	3	1	2	-	-	-
CO5	2	2	3	2	3	3	3	-	3	3	1	3	-	-	-
22POE$09	**2**	**2**	**3**	**2**	**3**	**1**	**3**	**-**	**3**	**3**	**2**	**3**	-	-	-
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	15	52	33	-	-	-	100
CAT2	15	68	17	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	100	-	-	-	100
ESE	9	75	16	-	-	-	100

22POE$10	**MANAGERIALECONOMICS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	*To introduce the fundamental economic principles necessary for production managers	
UNIT- I	**FUNDAMENTALS OF MANAGERIAL ECONOMICS**	**9 Periods**
Introduction to Economics - Scope of Managerial Economics - General Foundations of Managerial Economics: Economic Approach, Working of Economic System and Circular Flow of Activities - Economics and Business Decisions: Relationship between Economic Theory and Managerial Economics - Role of managerial Economics in Decision making - Concept of Economic Rationality - Opportunity Cost - Marginal and Incremental approach.		
UNIT- II	**DEMAND ANALYSIS**	**9 Periods**
Demand and Supply - Determinants of Demand - Demand Estimation and Forecasting - Price Elasticity of Demand - Price Elasticity- Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Advertisement or Promotional Elasticity - Elasticity of Supply.		
UNIT- III	**DEMAND THEORY**	**9 Periods**
Utility Analysis - Total and Marginal Utility - Law of Diminishing marginal utility - Indifference curve analysis - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.		
UNIT- IV	**THEORY OF PRODUCTION AND COST**	**9 Periods**
The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts – CostMinimization and Optimal Input Substitution - The Cost Function - Breakeven analysis,Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions andEconomies of Scope - Learning curve.		
UNIT- V	**THEORY OF MARKET AND PRICING**	**9 Periods**
Forms of Markets: Meaning and Characteristics - Market Equilibrium: Practical Importance, Market Equilibrium and Changes in Market Equilibrium. Pricing Functions: Market Structures - Pricing and output decisions under different competitive conditions: Monopoly Monopolistic completion and Oligopoly.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Maheshwari.Y* ***"Managerial Economics",*** *Prentice Hall of India, 2012*
2	*Thomas and Maurice* ***"Managerial Economics: Concept and Applications",*** *McGrawHill, 2005*

REFERENCES:

1	*D.N. Dwivedi,* ***"Managerial Economics",*** *Vikas Publishing house, 2015*
2	*Christopher R Thomas, S Charles Maurice,* ***"Managerial economics",*** *Mcgraw Hill, 2014*
3	*M. A. Beg, "****Managerial Economics****",Global Professional Publishing Ltd, 2010*
4	*K.C. Sankaranarayanan, "****Managerial Economics****", CBS, 2015*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain fundamentals of managerial economics	K2
CO2	Discuss the dynamics of Demand	K3
CO3	Explain about various theories of demand	K3
CO4	Discuss about the factors influencing production	K4
CO5	Describe about the theory of market and pricing method	K4

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	1	3	1	3	3	-	1	3	3	3	-	1	2
CO2	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO3	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
CO4	1	3	2	3	1	3	3	-	1	3	3	3	1	1	2
CO5	1	3	2	3	1	3	3	-	1	3	3	3	-	1	2
22POE$10	**1**	**3**	**2**	**3**	**1**	**3**	**3**	-	**1**	**3**	**3**	**3**	1	**1**	**2**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2

ASSESSMENT PATTERN– THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	50	-	-	-	-	100
CAT2	50	50	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	33.33	33.33	33.33	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	33.33	33.33	33.33	-	-	-	100
ESE	42	42	16	-	-	-	100

22NOE$11	MEASUREMENT AND CONTROL *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To teach about the concepts of variable sensors for industrial parameter measurement and to impart knowledge on automatic control system	
UNIT - I	**INTRODUCTION TO MEASUREMENTS**	**9 Periods**
Elements of measurement system - Classification of Instruments – Static and dynamic characteristics of a measurement system - Errors in measurement - Calibration of instruments.		
UNIT - II	**STRAIN AND DISPLACEMENT MEASUREMENT**	**9 Periods**
Strain: Types of strain gauges, theory of operation, strain gauge materials, strain gauge circuits and applications. Displacement: Resistive potentiometer: Linear, circular and helical – LVDT - RVDT - Capacitance transducers – Piezoelectric transducers – Hall Effect devices - Proximity sensors.		
UNIT - III	**PRESSURE AND TEMPERATURE MEASUREMENT**	**9 Periods**
Pressure: Mechanical devices: Diaphragm, bellows, and bourdon tube - Electrical devices: Variable resistance, inductance and capacitance transducers. Temperature: Resistance type temperature sensors: RTD , Thermocouples, Thermopiles and Thermistor - Laws of thermocouple – Radiation methods for temperature measurement.		
UNIT - IV	**FLOW AND LEVEL MEASUREMENT**	**9 Periods**
Flow: Variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle, Pitot tube - Variable area type: Rotameter - Turbine flow meter - Electromagnetic flow meter - Ultrasonic flow meter. Level: Resistive, inductive and capacitive techniques – Ultrasonic methods – Air purge system .		
UNIT - V	**AUTOMATIC CONTROL SYSTEM**	**9 Periods**
Elements of control system – Concept of open loop and closed loop systems – Mathematical modelling - Controllers – Brief idea of Proportional, Derivative and Integral Modes – Pneumatic Controller – Hydraulic Controller.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*A.K. Sawhney, Puneet Sawhney, **"A Course in Mechanical Measurements and Instrumentation & Control"** Dhanpat Rai & Co, 2012.*
2	*S. K. Singh, "**Industrial Instrumentation and Control**", McGraw Hill Publication, 3rd Edition, 2016.*

REFERENCES:

1	*William Bolton, "**Instrumentation and Control Systems**," Newnes, Publication, 3rd Edition, 2021.*
2	*E. D. Doeblin, **"Measurement Systems: Application and Design"**, McGraw Hill Publication, 6th Edition, 2017.*
3	*E.W. Golding and F.C. Widdis, **"Electrical Measurements and Measuring Instruments"** A.H.Wheeler and Co., 5th Edition, 2011.*
4	*Alan S. Morris, **"Measurement and Instrumentation Principles",** Butterworth-Heinemann Publications, 3rd Edition, 2011.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Describe the methods of measurement and classification of measuring instruments.	K2
CO2	Suggest suitable sensor for the measurement of strain and displacement.	K2
CO3	Explain the construction and working of transducers for pressure and temperature measurement.	K2
CO4	Elucidate the characteristics of flow and level measuring instruments.	K2
CO5	Elaborate the concept of automatic control system.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	-	-	3	3
22NOE$11	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**

b) CO and Key Performance Indicators mapping

CO1	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO2	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.3.1, 2.3.2, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4
CO3	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO4	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2,2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2
CO5	1.1.1, 1.1.2, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing(K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	40	60	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	30	70	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70	-	-	-	-	100
ESE	40	60	-	-	-	-	100

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22NOE$12	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To elaborate on the basic concept of automation, including the necessary components and various automation controllers utilized in industrial automation.	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
Automation overview – Requirement of automation systems – Architecture of industrial automation system –Industrial bus systems: Modbus and Profibus.Introduction to Industry 4.0 and its evolution.		
UNIT - II	**AUTOMATION COMPONENTS**	**9 Periods**
Sensors for temperature – Pressure – Force – Displacement - Speed – Flow- level – Humidity and pH measurement. Actuators – Process control valves –Power electronic drives: DIAC- TRIAC –power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control.		
UNIT - III	**PROGRAMMABLE LOGIC CONTROLLERS**	**9 Periods**
PLC Hardware – power supplies and isolators –Relays – Switches -Seal-in circuits – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics.		
UNIT - IV	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers.		
UNIT - V	**SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS**	**9 Periods**
Introduction - Supervisory Control and Data Acquisition Systems – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*
2	*S.K. Singh "**Industrial Instrumentation and Control**", 3rd Edition, McGraw Hill Companies, 2004.*

REFERENCES:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee, "**Introduction to Industrial Internet of Things and Industry 4.0**", CRC Press, 1st edition, 2021*
2	*Bela G Liptak, "**Process software and digital networks – Volume 3**", 4th Edition, CRC press, 2012.*
3	*Romily Bowden, "**HART application guide and the OSI communication foundation**",1999.*
4	*John.W. Webb Ronald A Reis, "**Programmable Logic Controllers - Principles and Applications**", Prentice Hall Inc., 5th Edition, 2003.*
5	*M. P. Lukcas, "**Distributed Control Systems**", Van Nostrand Reinhold Co., 1986.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
CO1	Elaborate the basic architecture of automation systems and Industry 4.0.	K2
CO2	Describe the various automation components and industrial bus system involved in industrial automation	K2
CO3	Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications	K3
CO4	Illustrate the functionary components and supervisory control of DCS with relevant diagrams	K2
CO5	Describe the basics of SCADA technology.	K2

COURSE ARTICULATION MATRIX

a) CO/PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO2	3	2	1	-	-	-	-	-	-	-	-	-	1	3	3
CO3	3	3	2	2	-	-	-	-	1	-	-	2	1	3	3
CO4	3	2	2	-	-	-	-	-	-	-	-	-	1	3	3
CO5	3	2	`1	-	-	-	-	-	-	-	-	-	1	3	3
22NOE$12	3	3	2	1	-	-	-	-	1	-	-	1	1	3	3

b) CO and Key Performance Indicators mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 9.1.1, 9.1.2, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2.
CO4	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.
CO5	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3,3.1.1, 3.1.2, 3.1.3, 3.3.1,3.3.2.

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Remembering (K1)%	Understanding (K2) %	Applying (K3)%	Analyzing(K4)%	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	60	20	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	60	20	-	-	-	100
ESE	20	60	20	-	-	-	100

22SOE$13	**PROGRAMMING IN JAVA** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of this course is to provide students with the essential Java constructs necessary for developing an object-oriented program.	
UNIT – I	**FUNDAMENTALS OF JAVA PROGRAMMING**	**9 Periods**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.		
UNIT – II	**THREADS , I/O AND STRING HANDLING**	**9 Periods**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling- Input/Output: Exploring java.io		
UNIT – III	**EVENT HANDLING**	**9 Periods**
Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - Menus - Introducing Swing		
UNIT – IV	**IMAGING AND DATABASE CONNECTIVITY**	**9 Periods**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity		
UNIT – V	**NETWORKING**	**9 Periods**
Networking – Remote Method Invocation – Java Beans –Java servlets		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOKS

1	*Herbert Schildt, "Java, **The Complete Reference** ", Tata McGrawHill, 12th Edition, 2022*

REFERENCES

1	*Deitel .H.M and Deitel.P.J, " **Java: How to Program** ", Pearson Education Asia, 9th Edition 2011*
2	*Lay.S&Horstmann Gary Cornell, " **Core Java Vol I** ", The Sun Microsystems & press Java Series, 9th Edition, 2012*
3	*NPTEL Course : "**PROGRAMMING IN JAVA**" **https://archive.nptel.ac.in/courses/106/105/106105191/***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling	K4
CO2	Write java program using multithreading and string handling	K3
CO3	Write java programs for managing events and to access database	K4
CO4	Write java programs to display and manipulation of graphical images	K3
CO5	Develop client server programs using RMI and servlets	K3

COURSE ARTICULATION MATRIX:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	-	2	-	-	1	2	2
CO2	2	1	2	2	1	-	-	-	-	2	-	-	-	2	3
CO3	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO4	2	1	2	2	1	-	-	-	-	2	-	-	1	2	3
CO5	2	1	2	2	1	-	-	-	-	2	-	2	1	2	3
22SOE$13	2	2	2	2	1	-	-	-	-	2	-	1	1	2	3

b) CO and Key Performance Indicators Mapping	
CO1	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO2	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2,10.1.1,10.1.2,10.1.3
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.1.1, 5.2.2,10.1.1,10.1.2,10.1.3,12.1.1,12.2.1,12.2.2

ASSESSMENT PATTERN – THEORY							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	-	30	40	30	-	-	100
CAT2	10	30	40	20	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	-	70	30	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	-	50	50	-	-	100
ESE	-	30	40	30	-	-	100

22SOE$14	**NETWORK ESSENTIALS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of the course is to understand the basics of networking and able to configure and troubleshoot switches and routers.	
UNIT – I	**INTRODUCTION**	**9 Periods**
Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics		
UNIT – II	**WIRELESS NETWORKING**	**9 Periods**
Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation		
UNIT – III	**ADDRESSING AND ROUTING FUNDAMENTALS**	**9 Periods**
IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet		
UNIT – IV	**ROUTING PROTOCOLS**	**9 Periods**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.		
UNIT – V	**TROUBLESHOOTING AND NETWORK SECURITY**	**9 Periods**
Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Jeffrey S.Beasley Piyasat Nilkaew "**Network Essentials**" 3 rd Edition, Pearson, 2018*
2	*Larry L. Peterson and Bruce S. Davie "**Computer Networks, A Systems Approach**" 5 th edition, Morgan Kaufmann Publishers Inc, 2014.*

REFERENCES :

1	*Behrouz A. Forouzan, "**Data Communications and Networking with TCP/IP Protocol Suite**", Sixth Edition TMH, 2022.*
2	*James F. Kurose, Keith W. Ross, "**Computer Networking, A Top-Down Approach Featuring the Internet**", Eighth Edition, Pearson Education, 2021.*
3	*Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "**Computer Networks: An Open Source Approach**", McGraw Hill, 2012.*
4	*Nader F. Mir, "**Computer and Communication Networks",** Second Edition, Prentice Hall, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP	K2
CO2	Explain the significance of wireless networks and configure a Wireless LAN	K3
CO3	Configure a switcher and a router	K3
CO4	Describe basic routing algorithms and network services	K3
CO5	Troubleshoot the router and switch interface	K3

a) CO and PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	-	1	-	-	-	-	-	-	1	2	-
CO2	2	3	-	-	-	1	-	-	-	-	-	-	1	2	-
CO3	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO4	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
CO5	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-
22SOE$14	2	3	-	2	2	1	-	-	-	-	-	-	1	2	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.4.4, , 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO2	1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO3	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO4	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2
CO5	1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	35	35	-	-	-	100
CAT2	10	45	45	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	-	50	50	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	-	50	50	-	-	-	100
ESE	10	40	50	-	-	-	100

22I0E$15	**VIDEO CREATION AND EDITING** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	Upon completion of the course the students will be familiar with the principles and techniques of video creation and editing, video production equipment and software, visual storytelling and video production, planning, executing, and editing video projects. also able to foster critical thinking and creativity in developing and executing video projects.	
UNIT – I	**INTRODUCTION TO VIDEO CREATION AND EDITING**	**9 Periods**
Overview of video creation and editing -Brief history of video and film production -Understanding visual storytelling: developing documentary and dramatic projects- introduction to digital and film systems		
UNIT – II	**PRE-PRODUCTION**	**9 Periods**
Developing a concept and idea - Scriptwriting and storytelling -The Digital image - Film systems and cameras -The film image - Case Study : Non linear editing system		
UNIT – III	**PRODUCTION**	**9 Periods**
Camera operation and techniques: The video camcorder- The Lens - Lighting and sound recording techniques - Directing actors and crew -Conducting interviews -Shooting the movie - Case Study : Professional video zoom lenses		
UNIT – IV	**POST-PRODUCTION**	**9 Periods**
Picture and Dialogue editing - Editing digital video -sound editing and mixing -Color grading and correction-Sound editing and mixing – working with film in post production Case Study : Digital Audio Recording		
UNIT – V	**DISTRIBUTION AND PROMOTION**	**9 Periods**
Presenting the project - funding sources - budgets- business arrangements- legal and copyright issues- distribution and marketing - publicity and the marketing campaigns-building and sustaining a career - Case Study : Creating a short movie.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Steven Ascher and Edward Pincus,The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age,Fifth edition Penguin Publishing Group, 2012

REFERENCES :

1	Walter Murch,In the Blink of an Eye: A Perspective on Film Editing", Silman-James Press,2001
2	Karel Reisz and Gavin Millar,The Technique of Film Editing",second edition ,Taylor and Francis Group 2017
3	Ken Dancyger, The technique of film and video editing , fifth edition , Elsevier 2011.
4	Chris Kenworthy,Digital video production cookbook, OReillyMedia ,2006
5	Mark Brindle, The Digital Filmmaking Handbook ,Quercus Publishing, 2014

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Demonstrate an understanding of the history and evolution of video production and editing.	K2
CO2	Develop and execute a concept, script, and storyboard for a video project	K3
CO3	Plan and prepare for a video shoot, including casting, location scouting, and budgeting.	K3
CO4	Edit and assemble video footage using basic and advanced editing techniques.	K2
CO5	Promote and distribute the final video on various platforms.	K1

Course Articulation Matrix														
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	1	-	-	-	-	-	-	-	-	1	1
CO2	1	2	3	2	3	-	-	-	-	-	-	-	1	1
CO3	1	2	1	3	3	-	1	-	3	1	2	-	1	1
CO4	1	2	2	2	3	3	-	-	3	1	2	-	1	1
CO5	1	2	2	2	3	3	1	3	3	3	2	-	1	1
22IOE$15	1	2	2	2	2	1	1	1	2	1	1	-	1	1
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO	Key Performance Indicators
CO1	1.1.1,1.2.1,1.31,2.1.1,2.1.2,2.2.4,2.4.1,3.1.4,3.4.1,4.1.3,
CO2	1.1.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.4.3,3.1.1,3.1.2,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1, 4.1.3,4.2.1,4.3.1,4.3.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,
CO3	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,3.4.2,4.1.1,4.1.3,4.1.4,4.2.2, 4.3.1,4.3.2,4.3.3,,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,7.1.1,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.2.1,11.3.1,1 1.3.2
CO4	1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,,3.3.2,3.4.2,4.1.1,4.1.3,4.2.1 , ,4.3.1,4.3.2,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,6.1.1,6.1.2,,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.3.1,11.3.2
CO5	1.1.1 , 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4 2.3.2, 2.4.3, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.3, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.12, 8.1.1, 8.2.1,8.2.2, , 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3,9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3,10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1

ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22IOE$16	DIGITAL MARKETING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To give insight on the framework to analyze, strategies and plan digital marketing and communication activities for typical marketing situations. Familiarize with the key tools and techniques of digital marketing that are popularly used by professionals in the real world of digital marketing and help them develop the ability to formulate and analyze key metrics to evaluate the performance of typical digital marketing efforts.	
UNIT – I	**INTRODUCTION TO DIGITAL MARKETING**	**9 Periods**
Basics of Digital Marketing - online marketplace analysis: digital marketing environment - consumer choice and digital influence online consumer behavior-competitors -suppliers- new channel structures - rate of environment change - economic force-political force -legal force - social force- cultural force.		
UNIT – II	**DIGITAL MARKETING STRATEGY DEVELOPMENT**	**9 Periods**
Digital marketing strategy - The impact of digital media and technology on the marketing mix: product- price-place-promotion -people, process and physical evidence - relationship marketing using digital platforms: the challenge of customer engagement - customer lifecycle management		
UNIT – III	**DIGITAL MARKETING IMPLEMENTATION AND PRACTICE**	**9 Periods**
Delivering the online customer experience: planning website design and redesign projects - initiation of the website project - defining site or app requirement - designing the user experience - development and testing of content - site promotion or traffic building - campaign planning for digital media		
UNIT – IV	**MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS**	**9 Periods**
Search engine marketing - online public relations - affiliated marketing - interactive display advertising -email marketing and mobile text messaging- social media and viral marketing - offline promotion techniques		
UNIT – V	**EVALUATION OF DIGITAL CHANNEL PERFORMANCE**	**9 Periods**
Create a performance management system - performance metric framework - tools and techniques for collecting metrics -customer experience and content management - online consumer behavior- online retailing - customer acquisition in B2B marketing -online inter- organizational trading		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing,sixth edition, 2016

REFERENCES :

1	Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017
2	Mathur, Vibha, Arora, Saloni,"DigitalMarketing",PHI Learning Pvt. Ltd.,2020
3	Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Compaigns, Wiley 2016
4	Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques,BPB PUBN,2021
5	Seema Gupta , Digital Marketing,Third Edition, McGraw Hill 2022
6.	Simon Kingsnorth, Digital Marketing Strategy : An Integrated Approach to Online Marketing, Kogan page,2022

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Explain the role and importance of digital marketing in a rapidly changing business landscape	K1
CO2	Discuss the key elements of a digital marketing strategy	K2
CO3	Demonstrate advanced practical skills in common digital marketing tools such as Social media and Blogs	K2
CO4	Demonstrate advanced practical skills in common digital marketing tools such as SEM	K2
CO5	understand online consumer behavior and influence the extent to which individuals are likely to engage with the digital marketplace	K2

Course Articulation Matrix (Times New Roman, Size 11)

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO2	1	1	2	2	-	-	-	-	-	-	-	-	2	2
CO3	1	1	2	2	3	-	-	-	-	-	-	-	2	2
CO4	1	1	2	2	3	2	3	3	3	3	3	3	2	2
CO5	1	1	2	2	1	-	3	3	3	3	3	3	2	2
22IOE$16	1	1	2	2	1	1	1	1	1	1	1	1	2	2

1– Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO	Key Performance Indicators
CO1	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO2	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,
CO3	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2
CO4	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 5.2.2,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1,10.1.1, 10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1 ,12.3.2
CO5	1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1, 10.1.1,10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2 ,12.3.1,12.3.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Rememberin g (K1) %	Understandin g (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluatin g (K5) %	Creatin g (K6) %	Total %
CAT1	30	30	40	-	-	-	100
CAT2	30	30	40	-	-	-	100
Assignment 1	30	30	40	-	-	-	100
Assignment 2	30	30	40	-	-	-	100
Other mode of internal assessments, if any	-	-	-	-	-	-	-
ESE	30	30	40	-	-	-	100

22BOE$17	**PRINCIPLES OF FOOD TECHNOLOGY** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To learn about the various food constituents and its additives. To learn about various microbes associated with food. To learn about different food processing and preservation techniques.	
UNIT – I	**FOOD AND ENERGY**	**9 Periods**
Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.		
UNIT – II	**FOOD BORNE DISEASES**	**9 Periods**
Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.		
UNIT – III	**FOOD ADDITIVES**	**9 Periods**
Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.		
UNIT – IV	**FOOD PRESERVATION**	**9 Periods**
Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.		
UNIT – V	**FOOD PACKAGING**	**9 Periods**
Types of packaging material and containers; Interactions between packaging and foods; Packing - meat, dairy, fresh fruits and vegetables, beverages and confectionaries; Food packaging closure and sealing system; Nutrition labelling and legislative requirements.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*T.P. Coultate , **Food – The Chemistry Of Its Components**, 6th Edn. Royal Society,London, 2015.*
2	*W.C. Frazier And D.C. Westhoff , **Food Microbiology**, 4th Ed., Mcgraw-Hill Book Co., NewYork 2013.*

REFERENCES

1	*Srinivasan Damodaran and Kirk L. Parkin., "Fennema's Food Chemistry", CRC Press, 5 thedition. 2017.*
2	*Fellows P.J, "Food Processing Technology: Principles and Practices", Woodhead Publishing 4 th edition,2016·*
3	*B. Sivasanker , Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	learn different constituents present in food and microorganism involved in processing of food.	K1
CO2	learn principles and different preservations techniques of food can also be known.	K1
CO3	learn techniques involved in modern food processing and impact of the process on food quality.	K2
CO4	Explain various preservation and packaging techniques for food product	K2
CO5	Describe the relationship between food and microorganism that basis for fermentation and preservation	K2

a) Course Articulation Matrix

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	-	-	1	-	-	-	-	2	3	-	-	1	3
CO2	1	-	-	-	-	-	-	-	-	3	-	-	1	3
CO3	1	-	-	2	-	2	-	-	-	3	-	-	1	3
CO4	1	-	1	-	-	-	-	-	-	3	-	-	1	3
CO5	1	-	2	-	-	-	-	-	-	3	-	-	1	3
22BOE$17	1	-	1	1	-	2	-	-	2	3	-	-	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.4.2, 2.1.3
CO2	1.4.1, 3.1.3
CO3	1.4.4, 2.1.4
CO4	1.4.1, 2.1.3,3.4.2
CO5	1.4.1,2.2.1

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	50	50	-	-	-	-	100
CAT2	60	40	-	-	-	-	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	50	50	-	-	-	-	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	50	50	-	-	-	-	100
ESE	50	50	-	-	-	-	100

22BOE$18	**BIOLOGY FOR ENGINEERS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	1. Understand and interpret commonly reported statistical measures published in healthcare research 2. Analyze the different type of data using appropriate statistical software 3. Demonstrate a good understanding of descriptive statistics and graphical tools 4. Explain fundamental concepts of estimation and hypothesis testing and be confident when interpreting P values and confidence intervals	
UNIT – I	**BASICS OF CELL BIOLOGY**	**9 periods**
An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion.		
UNIT – II	**BASICS OF MICROBIOLOGY**	**9 periods**
Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12.		
UNIT – III	**HUMAN ANATOMY AND PHYSIOLOGY**	**9 periods**
Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.		
UNIT – IV	**BIO MOLECULES AND IMMUNE SYSTEM**	**9 periods**
Introduction to Biochemistry-classification-structure and properties of carbohydrates- proteins- lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.		
UNIT-V	**APPLIED BIOLOGY FOR ENGINEERS**	**9 periods**
Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*Darnell J, Lodish H, Baltimore D.* ***"Molecular Cell Biology"****, W.H.Freeman; 8th Edition, 2016.*
2	*Pelczar MJ, Chan ECS and Krein NR,* ***"Microbiology",*** *Tata McGraw Hill, 5thEdition, New Delhi.2001.*
3	*Wulf Cruger and Anneliese Cruger,* ***"A Textbook of Industrial Microbiology",*** *Panima Publishing Corporation, 2nd Edition, 2000.*

REFERENCES

1	*David L. Nelson and Michael M Cox,* ***"Lehninger's Principles of Biochemistry",*** *Macmillan Worth Publisher, 4th edition, 2004.*
2	*Brain R.Eggins ,* ***"Chemical Sensors and Biosensors",*** *John Wiley & Sons, 2002.*
3	*Anton Moser,* ***"Bioprocess Technology, Kinetics and Reactors",*** *Springer, Berlin (Verlag),1st edition, 1998*
4	*Kuby J,* ***"Immunology",*** *WH Freeman & Co., 7th edition, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the functions of cell and their structural organization	K1
CO2	Describe the mechanisms and role of cell in immune system	K1
CO3	Get familiarized biomolecules and human anatomy system	K2
CO4	Illustrate the applications of microbes in industrial process	K3
CO5	Apply the engineering concepts in biology	K3

a) Course Articulation Matrix

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO1	-	1	-	-	-	2	2	2	-	-	1	2	2	2
CO2	1	-	-	1	1	-	-	2	3	3	2	2	1	3
CO3	1	1	-	-	-	-	-	1	1	-	-	-	1	3
CO4	-	-	-	-	1	-	-	2	3	3	1	1	1	3
CO5	-	2	-	1	3	-	-	-	-	-	-	-	2	2
22BOE$18	1	1	-	1	2	2	2	2	3	3	2	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.2, 6.1.1, 7.1.2, 8.1.1, 11.1.1, 12.1.2
CO2	1.1.1, 4.2.1, 5.2.1, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2
CO3	1.1.1, 2.1.1, 8.1.1, 9.1.1
CO4	5.2.1, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2
CO5	1.1.1,2.2.2, 4.2.1, 5.2.1, 6.1.1,7.1.2, 8.1.1, 9.1.1,9.2.1,10.1.1, 10.1.2, 11.1.1, 12.1.2

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	50	10	10	10	10	10	100
CAT2	50	10	10	10	10	10	100
Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1	20	20	20	20	10	10	100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	20	20	20	10	10	100
ESE	50	10	10	10	10	10	100

22CVA$07	RECENT TRENDS IN DESIGN AND DETAILING OF STRUCTURES

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objective	To equip students to understand basic requirements to enable to prepare neat and proportionate sketches to detail various structural members and their connections requirements.	
UNIT – I	**DETAILING OF BASIC RC ELEMENTS**	**5 Periods**
Consequences due to Inadequate or Improper Detailing, General Detailing Requirements – cover, development length, Detailing of Slab (One – Way Simply Supported, One – Way Continuous Slab, Two – Way Simply Supported Slab and Two – Way Continuous Slab and Cantilever Slab). Detailing of Cross Section and Longitudinal Sections of Beams (Simply Supported Beam, Fixed Beam, Propped Cantilever Beam and Continuous Beam), Detailing of Column, Detailing of Isolated Sloped Footing and Combined Footing , Notes and Specifications.		
UNIT – II	**DETAILING OF SPECIAL RC STRUCTURAL ELEMENTS**	**5 Periods**
Detailing of Various Types of Stairs, Behaviour of RC Walls, Deep Beams and RC Brackets, Detailing of Retaining Wall, Detailing of Lift Wall, Detailing of Corbels and Brackets. Concepts in Design of Formwork, Sketches for Formwork and shuttering for slabs, beams, columns.		
UNIT – III	**DETAILING OF STEEL ELEMENTS**	**5 Periods**
Detailing of Truss with Welded Connections, Detailing of Truss with Bolted Connections, Detailing of Various Beam to Beam, Column to Beam, Column to Foundation, Beam to Slab Connections, and Introduction and Importance of various drawings prepared for steel structures like shop drawings, Structural Drawings, Fabrication Drawings etc., Idealization of Connection with respect to Erection Practices, Importance of Write Connection and its Feasibility at Site, Introduction and Importance of Splices in Detailing.		
Contact Periods: **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**		

TEXT BOOKS:

1	*N Krishna Raju, "**Structural Design and Drawing of Reinforced Concrete and Steel**", University Press,3rd Edition, 2009.*
2	*Krishna Murthy, "**Structural Design and Drawing – Concrete Structures**", CBS Publishers, New Delhi, Vol 2, 2018*

REFERENCES:

1	*SP: 34 (S & T) – 1987: **Handbook on Concrete Reinforcement and Detailing**. Bureau of Indian Standards, S & T/1987*
2	*M. Y. H. Bangash , "**Structural Detailing in Concrete**" 1992, Wiley–Blackwell*
3	*S. Kanthimathinathan, "**Manual for Detailing of Steel Structures**" Wiley-Dreamtech Press, 2019*
4	*IS 13920:2016, **Ductile Design And Detailing Of Reinforced Concrete Structures Subjected To Seismic Forces** - Code of Practice, Bureau of Indian Standards.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Detail the basic RC Elements	K3
CO2	Sketch the Special RC Elements and Formworks	K3
CO3	Prepare Structural Steel drawings detailing	K3

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	3	-	-	-	-	-	1	-	3	1
CO2	2	1	2	1	1	3	-	-	-	-	-	1	-	3	1
CO3	2	1	2	1	1	3	-	-	-	-	-	1	-	3	1
22CVA$07	2	1	2	1	1	3	-	-	-	-	-	1	-	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 3.1.1, 3.1.2, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.2.1, 4.3.1, 5.2.1, 6.1.1, 6.2.1, 12.2.1, 12.3.2
CO2	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3,3.1.1,3.1.2,3.1.4,3.1.5, 3.1.6,3.3.2, 4.2.1, 4.3.1, 5.2.1, 6.1.1, 6.2.1, 12.2.1,12.3.2
CO3	1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3,3.1.1,3.1.2,3.1.4,3.1.5, 3.1.6,3.3.2, 4.2.1, 4.3.1, 5.2.1, 6.1.1, 6.2.1, 12.2.1,12.3.2

22CVA$08	EMERGING CONSTRUCTION TECHNOLGIES FOR HOUSING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objective	To provide students with a comprehensive understanding of emerging construction technologies and their applications in housing construction.	
UNIT – I	**EMERGING CONSTRUCTION TECHNOLOGIES**	**5 Periods**
AR, VR and MR in construction - Integration of Internet of Things (IoT) devices for smart homes – Robots in construction and maintenance		
UNIT – II	**CIRCULAR ECONOMY**	**5 Periods**
Implementation of circular economy - principles in housing construction - Strategies for promoting social sustainability in housing developments		
UNIT – III	**DRONES, AI AND MACHINE LEARNING**	**5 Periods**
Application of drones and aerial imaging for site analysis and construction monitoring - Use of artificial intelligence (AI) and machine learning for predictive maintenance in housing infrastructure		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS :

1	*BMTPC,* ***Alternate & Innovative Construction Systems for Housing****, I K International Publishing House Pvt. Ltd., 1st edition ,2021*
2	*Andrew P Mccoy, Armin Yeganeh,* ***An Overview of Emerging Construction Technologies****, NAIOP,2021*

REFERENCES :

1	*Mike Riley & Alison Cotgrave,* ***Construction Technology 1: House Construction****, Bloomsbury Visual Arts; 4th ed. 2018*
2	*Sheri Koones,* ***Prefabulous: The House of Your Dreams Delivered Fresh from the Factory: Prefabulous Ways to Get the Home of Your Dreams****, Taunton press,2007.*
3.	*Kibert, C.J.,* ***Sustainable Construction: Green Building Design and Delivery****, John Wiley & Sons, 5th edition, 2019.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Utilize emerging technologies like AR, VR, and MR for enhanced project management and IOT devices to optimize construction processes.	K3
CO2	Implement circular economy principles for sustainable housing construction.	K3
CO3	Utilize drones, aerial imaging and apply AI and machine learning in housing infrastructure.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO2	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO3	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
22CVA $08	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2

22CVA$09	BUILDING MODELLING USING 3D REVIT ARCHITECTURE

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objective	To gain knowledge on designing sustainable building and infrastructure using BIM tools.	
UNIT – I	**INTRODUCTION TO REVIT ARCHITECTURE**	**5 Periods**
Revit Architecture user interface - The ribbon framework - Guidelines for using the interface - Using common modification tools – Viewing commands - Starting a new architecture project - Navigation tools		
UNIT – II	**BUILDING COMPONENTS AND BASIC MODELING**	**5 Periods**
Creating architectural walls - Adding doors and windows - Using editing tools - Working with datum planes and creating standard views - Basic building components: floors, roofs, ceilings, rooms, stairs, railing, and ramps - Adding site features		
UNIT – III	**ADVANCED 3D MODELING FOR ARCHITECTURAL DESIGN**	**5 Periods**
Modeling curtain walls - Modeling floors and ceilings - Modeling roofs - Modeling site and topography - Modeling masses - Modeling rooms and areas - Applying materials - Creating rendering views and walkthroughs - Autodesk 360 Rendering		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS :

1	*Wing, E. , "**Revit Architecture 2022: No Experience Required,**" Sybex; 2nd edition,2019*
2	*Kirby, L., Kim, M., & Krygiel, E. , "**Mastering Autodesk Revit 2022,**" Sybex,1st Edition,2017*

REFERENCES :

1	*Ascent, "**Autodesk Revit 2024 Structure fundamentals for structure**", Center for Technical Knowledge.*
2	*Sham Tickoo, "**Revit Architecture 2022: A Comprehensive Guide"***
3.	*James Vandezande, Eddy Krygiel, and Phil Read, "**Mastering Autodesk Revit Architecture 2021"***
4.	*Tatjana Dzambazova, Eddy Krygiel, and Greg Demchak, **"Introducing Autodesk Revit Architecture 2010"***
5.	*Elise Moss, "**Revit Architecture 2015 Basics"***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Navigate the Revit Architecture interface and initiate new projects confidently.	K1
CO2	Create various building components and incorporate site features effectively.	K3
CO3	Model complex architectural elements and apply materials accurately.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO2	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO3	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
22CVA $09	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2

22CVA$10	BUILDING PLAN WITH BYE-LAWS

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	To impart knowledge on the building bye -laws and to emphasize the significance of codes of practice in construction sector.	
UNIT – I	**INTRODUCTION TO BUILDING BYE-LAWS**	**3 Periods**
Introduction to Building Bye Laws and regulation, their need and relevance, General definitions such as building height, building line, FAR, Ground Coverage, set back line. Introduction to Master Plan and understanding various land uses like institutional, residential etc. - Terminologies of Building bye-laws.		
UNIT – II	**ROLE OF STATUTORY BODIES**	**3 Periods**
Role of various statutory bodies governing building works like development authorities, municipal corporations etc. Local Planning Authority, Town and Country planning organization, Ministry of urban development.		
UNIT – III	**APPLICATION OF BUILDING BYE-LAWS**	**3 Periods**
Interpretation of information given in bye laws including ongoing changes as shown in various annexure and appendices. Application of Bye-laws like structural safety, fire safety, earthquake safety, basement, electricity, water, and communication lines in various building types.		
UNIT – IV	**INTRODUCTION TO CODES OF PRACTICE**	**3 Periods**
Introduction to various building codes in professional practice - Codes, regulations to protect public health, safety and welfare - Codes, regulations to ensure compliance with the local authority.		
UNIT – V	**APPLICATION OF CODES OF PRACTICE**	**3 Periods**
Applications of various codes as per various building types. Bureau of Indian Standards, Eurocode – Introduction to other international codes.		
Contact Periods **Lecture: 15 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 15 Periods**		

TEXT BOOKS:

1.	*Dr.Kumara Swamy, A.K.Kameswara Rao, **"Building Planning and Drawing"**,Charotar Publishing Housing Pvt.Ltd.,2015.*
2.	***"Model Building Bye-Laws (MBBL) – 2016"**, Town and Country Planning Organization, Ministry of Housing and Urban Affairs, Government of India.*

REFERENCES:

1	***"National Building Code of India 2016 – SP 7"**, NBC 2016, Bureau of Indian Standards.*
2	***"Model Building Bye-Laws (MBBL) – 2016"**, Town and Country Planning Organization, Ministry of Housing and Urban Affairs, Government of India.*
3	***"Unified Building Bye-laws for Delhi 2016"**, Nabhi Publications, 2017.*
4	***"Building Bye Laws"**,* Mukesh *Mittal, Graphicart publishers, Jaipur, 2013.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the building bye-laws in planning, design and construction works.	K3
CO2	Familiarize with the role of various statutory bodies.	K2
CO3	Execute safety related work practices in the construction sector.	K3
CO4	Ensure compliance with the rules and regulations in design and construction practices.	K3
CO5	Perform design and construction practices based on national and international codal provisions.	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	2	2	2	-	1	1	-	1	-	-	-	-	-	-
CO2	-	2	2	2	-	1	1	-	1	-	-	-	-	-	-
CO3	-	2	2	2	-	1	1	-	1	-	-	-	-	-	-
CO4	-	2	2	3	-	1	2	-	1	-	-	1	-	-	-
CO5	-	2	2	3	-	1	2	-	1	-	-	1	-	-	-
22CVA$ 10	**-**	**2**	**2**	**3**	**-**	**1**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO2	2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO3	2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.3.1,6.1.1,6.2.1,7.1.2,7.2.2,9.1.2
CO4	2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2
CO5	2.2.3,2.2.4,2.4.2,3.1.5,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.3.1,6.1.1,6.2.1,7.1.2,7.2.1,7.2.2,9.1.2,12.3.2

22CVA$11	ENVIRONMENTAL IMPACT ASSESSMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	2	0	0	2

Course objectives	To understand the importance of Sustainability, environment impact assessment by studying the impact on water, air and soil along with their Environment management Plan.	
UNIT – I	**INRODUCTION**	**6 Periods**
Impact of development projects – Sustainable development – Need for Environmental Impact Assessment (EIA) – Environmental Impact statement (EIS) – EIA Capability and limitations – Legal provisions on EIA –Stages of EIA, Types of EIA.		
UNIT – II	**METHODOLOGIES**	**6 Periods**
Methods of EIA – Assessment methodology - Check lists- Matrices – Networks – Cost benefit analysis – Analysis of alternatives.		
UNIT – III	**PREDICTION AND ASSESSMENT**	**6 Periods**
Assessment of impact on land, water, air, social & cultural activities and on flora and fauna – mathematical model – public participation.		
UNIT – IV	**ENVIRONMENTAL MANAGEMENT PLAN**	**6 Periods**
Plan for mitigation of adverse impact on Environment – Options for mitigation of impact on water, air, land and on flora and fauna- addressing the issues related to the project affected people. Post project monitoring.		
UNIT – V	**CASE STUDIES**	**6 Periods**
EIA for Infrastructure projects – Dams – Highways – Multi storey buildings – water supply and Drainage projects – wastewater treatment plants.		
Contact Periods: **Lecture: 30 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 30 Periods**		

TEXTBOOKS:

1	*V.S. Kulkarni,* ***"A Handbook of Environment Impact Assessment",*** *Scientific Publishers (P) Ltd., 2023.*
2	*M. Anji Reddy,* ***"Environment Impact Assessment: Theory and Practice"****, BSP Books Pvt.Ltd*
3	*Dr. Dinesh Nalage,* ***"Environmental Impact Assessment"****, Gaurang Publishing Globalize Pvt.Ltd*

REFERENCES:

1	*Dr. Arjun kumar A. Rathi,* ***" Anatomy of the Indian Environmental Impact Assessment Practice - Learnings for the EIA Professionals and Policymakers"*** *White Falcon Publishing, 2023.*
2	*Dr. Mahesh R.Sharanappa,* ***"Laws Relating to Environmental Impact Assessment****, Codex International Publishers, 2022*
3	*Sam Mannan, Lees'* ***Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control****, 4th Edition, Butterworth Heineman, 2012.*
4	*Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Identify the importance of EIA in project development.	K2
CO2	Apply the different methodologies for Environmental impact prediction and assessment.	K2
CO3	Evaluate the environmental impact assessment and environmental management plans.	K2
CO4	Assess the environmental impact assessment reports	K2
CO5	Able to acquire knowledge on different case study projects and their impact assessment.	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1	2		1	-	-	-	-	-	-	-	2	-	-	1
CO2	-	-	1	2	-	2	1	-	-	-	-	1	-	-	1
CO3	-	-		2	1	1		-	-	-	-	1	-	-	1
CO4	1	1	2	2	1	2	1	-	-	-	-	1	-	-	1
CO5	-	-	1	2	2	3	3	-	-	-	-	2	-	-	1
22CVA $11	**1**	**2**	**2**	**2**	**2**	**3**	**3**	-	-	-	-	**2**	-	-	**1**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
CO1	1.1.1,1.1.2.2.4,2.4.3,4.1.1,4.1.2,6.1.1,12.1.1,12.2.2
CO2	3.1.1,3.1.2,3.2.1,3.3.2,3.4.2,4.1.1,4.1.2,4.3.1,6.1.1,7.1.2
CO3	4.1.1,4.1.2,4.2.1,4.3.4,5.1.2,5.2.1,5.3.2,6.1.1,7.1.2,7.2.2,12.2.2
CO4	1.2.1,1.3.1,2.1.2,2.2.3,2.4.3,3.2.1,3.2.3,2.1,3.2.3,4.1.1,4.1.2,4.1.3,4.2.1,5.2.1,5.3.2,6.1.1,7.1.2,7.2.2
CO5	3.1.2,3.1.5,3.3.2,4.1.1,4.2.1,4.3.4,5.2.1,6.1.1,7.1.2

22CEE$12	SOFTWARE APPLICATIONS FOR PROJECT MANAGEMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	To gain knowledge on Primavera Project Management tools for various Engineering projects.	
UNIT – I	**PROJECT MANAGEMENT FUNDAMENTALS**	**5 Periods**
Introduction to portfolio, program, and projects - History of planning - Skills required for planning - Project phases and life cycle - Overview of Primavera P6, EPPM, and Cloud versions - Detailed exploration of Primavera architecture and database options.		
UNIT – II	**PROJECT SETUP AND MANAGEMENT**	**5 Periods**
Setting up enterprise project structure (EPS) - Establishing Organizational Breakdown Structure (OBS) - Administration, user control, and limited access provisions - Creation and management of projects, including project status, dates, codes, parameters, and calendars - Work Breakdown Structure (WBS) creation - Defining work packages and creating project activities - Activity codes, types, and duration - Activity relationships and logical connections - Resource loading and leveling - Applying scheduling constraints - Progress tracking and monitoring - Scheduling logs and constraint types.		
UNIT – III	**PROJECT MANGEMENT AND SCHEDULING**	**5 Periods**
Types of resources and units of measures - Creating resources and roles - Assigning resources to activities - Resource loading techniques - Activity costing and budget estimation - Cost comparison analysis - Identifying and managing project risks - Pre and post-risk analysis - Risk cost and impact assessment - Setting up and assigning baselines - Applying actuals - Delay impact analysis - Earned value analysis - S-curve analysis - Project issue register - Project tracking and reporting.		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS:

1	*Daniel L Williams, "**Oracle Primavera P6 Version 8: Project and Portfolio Management**", Packt Pub Ltd,2012*
2	*Okoro, Chukwuemeka, "**Project Management, Planning and Scheduling with primavera P6: A Practical guide**",2020*

REFERENCES:

1	*Harris, Paul E., "**Project planning and control using primavera P6 for all Industries including versions 4 to 7**" Eastwood Harris Ltd. 2010.*
2	*Harris Paul E, "**Planning and control using Oracle Primevera P6 versions 8 to 18 PPM professiona**". Eastwood Harris Pty Ltd. 2018.*
3.	*Kerzner, Harold., "**Project Management: A Systems Approach to Planning, Scheduling, and Controlling**", Wiley,12th edition,2017.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Describe project management fundamentals and develop essential planning skills.	K1
CO2	Establish enterprise project structures, organizational breakdown structures, and administer projects with control and use activity codes effectively.	K3
CO3	Apply resource loading techniques, estimate costs, conduct cost comparison analysis, and manage project risks and utilize advanced project management tools	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO2	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO3	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
CO4	3	1	1	-	3	-	-	-	-	1	-	3	2	3	2
CO5	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1
22CVA $12	3	1	1	-	3	-	-	-	-	1	-	3	2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO2	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2
CO3	1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.1.3,2.2.3,2.3.1,3.1.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,10.1.2,10.3.1,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2

22CVA$13	3D PRINTING TECHNOLOGY FOR CIVIL ENGINEERING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	**EEC**	**1**	**0**	**0**	**1**

Course Objective	To explore concepts, and classifications of concrete 3D printing, stages, materials, mix design, testing, and various printing technologies.	
UNIT – I	**INTRODUCTION TO CONCRETE 3D PRINTING**	**5 Periods**
3D PRINTING Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications - General considerations for 3D printing and additive fabrication - main concepts of 3D printing- 3D printing of cement-based materials - Classification of 3D printing methods for concrete – Limitations.		
UNIT – II	**MECHANICAL BEHAVIOR OF 3D PRINTED MATERIAL**	**5 Periods**
Mechanical performance of the cement material printing using extrusion - Mechanical behavior of 3D printed cement materials - Effect of extrusion on the mechanical characteristics of cement-based composites.		
UNIT – III	**VARIOUS PRINTING TECHNOLOGIES AND APPLICATIONS**	**5 Periods**
Application of 3D printing in construction industry and concrete product development – Industrial adoption of 3D printing - Impact of 3D printing technology on the construction, economy emerging on society - cost benefits of 3D printing in construction – recent advancements - Future of concrete 3D printing. Technical and non-technical challenges - Legislative Challenges and Trends		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXTBOOKS:

1	*Jay G. Sanjayan, Ali Nazari, and Behzad Nematollahi, "**3D Concrete Printing Technology**" , Elsevier; 2019 (ISBN - 978-0-12-815481-6).*
2	*Arnaud Perrot, "**3D Printing of Concrete: State of the Art and Challenges of the Digital Construction Revolution**" , Wiley; 2019, (ISBN: 978-1-786-30341-7)*

REFERENCES:

1	*Bakker, "**Smart Buildings: Technology and the design of the Built Environment**", RIBA Publishing, 2020*
2	*Wangler and R.J Flatt, "**Concrete and Digital fabrication: Digital Concrete 2018**", Conference Proceedings RILEM Book series, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Illustrate the general considerations, concepts, and classifications of concrete 3D printing	K3
CO2	Evaluate the Mechanical behavior of 3D-printed material	K2
CO3	Utilize 3D printing technologies based on its applications and impact	K2

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	2	3	3	-	2	2	1	-
CO2	3	3	3	3	3	3	3	2	3	3	1	2	2	1	-
CO3	3	3	3	3	3	3	3	2	3	3	2	2	2	1	-
22CVA$13	3	3	3	3	3	3	3	2	3	3	2	2	2	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO2	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2
CO3	1.2.1,1.3.1,1.4.1,2.1.1,2.2.2,2.3.1,3.1.1,3.1.3,3.1.5,3.2.1,3.3.1,4.1.1,4.1.2,4.1.3,4.1.4,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,10.1.1,11.1.1,12.1.1,12.1.2,12.2.2,12.3.1,12.3.2

22CVA$14	COMPREHENSIVE VIVA - CIVIL ENGINEERING

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

Course Objectives	To assess the student's comprehensive understanding and integration of core civil engineering subjects.	
UNIT – I	**STRUCTURALENGINEERING:MATERIALS,MECHANICS ,ANALYSIS, AND DESIGN**	**5 Periods**
Building Materials and Construction Properties, classification, tests, and applications of Cement, Lime, Concrete, Bricks, Aggregates, Timber, Steel, Plastics, Glass, FRP, Ceramics, Fly Ash, Aluminium.Concrete Technology-ingredients-properties-production-Mix Design. Construction Techniques-Site investigation-foundation construction-masonry-formwork-curing-finishing. Construction Equipment & Management-Planning-estimation-tendering-rate analysis-quality control and safety. **Solid Mechanics and Structural Analysis** Forces-Friction-Geometric properties of section. Stress-Strain-Elastic Constants-Mohr's Circle – Stress and strain transformation-Principal stresses-Theories of Failure--Shear Force and Bending Moment Diagrams-Theory of simple bending,shear and torsion. Analysis of Structures -Determinate and indeterminate beams, trusses, frames-Influence lines-Rolling loads-Virtual work-Unit load method-Cable structures-arches-plastic analysis. **Design of Structures** Reinforced Cement Concrete Structures-Limit state and working stress method-Design of beams-slabs-columns-footings-staircases-Retaining walls-water tanks-lintels. Prestressed Concrete–Materials-Analysis-losses-basic design. Steel Structures-Connections-Design of tension, compression, and flexural members-purlins-Plate girders-roof trusses-Industrial structures.		
UNIT – II	**GEO-ENGINEERING AND TRANSPORTATION ENGINEERING**	**5 Periods**
Engineering Geology Rocks and Minerals-Geological Maps and Sections-Site Investigation for Dams,Tunnels,Foundations-Landslides-Earthquakes-Groundwater. **Surveying and Geomatics** Basics of Surveying-Chains-Compass-theodolites-EDMs.Modern Instruments-Total Station-GPS-Traverse and Triangulation Surveys-Levelling and Contouring-Curves and Setting Out-Photogrammetry & Remote Sensing. **Geotechnical and Foundation Engineering** Soil Mechanics-Soil classification-consistency-permeability-compaction-consolidation-shear strength. Earth Pressure Theories-Rankine & Coulomb.Foundation Design-Shallow-deep foundations-bearing capacity-settlement analysis-pile foundations-Slope Stability-Retaining structures.Soil Exploration Methods-Ground Improvement Techniques-Geosynthetics. **Transportation Engineering** Highway Engineering-Planning-geometric design-pavement types.Traffic studies-trafficcontrol devices. Pavement materials and design methods (CBR, IRC). Railways-Components-track design-modernization. Airports-Runway-taxiway design-airport layout.		
UNIT – III	**FLUID, WATER RESOURCES, AND ENVIRONMENTAL ENGINEERING**	**5 Periods**
Fluid Mechanics and Hydraulic Engineering Fluid Properties-Pressure measurement-Flow measurement-Continuity-Bernoulli-Momentum equations. Open Channel Flow-Types-Critical flow-Hydraulic jump. Pipe Flow-Darcy-Weisbach, Major/minor losses-Pipe networks.Boundary Layer Theory-Drag & Lift.Modeling-Similitude. Hydraulic Machines-Pumps (Centrifugal, Reciprocating)-Turbines (Pelton, Francis, Kaplan). **Hydrology and Water Resources Engineering** Hydrological Cycle-Precipitation-Evaporation-Infiltration. Runoff Estimation-Hydrographs-Flood Routing-Drought Management. Groundwater Hydrology-Well Irrigation. Irrigation Engineering-		

Types-canal systems-crop water requirement. Design of Hydraulic Structures-Weirs-Barrages-Energy dissipators-Canal falls-Cross drainage works. River Training-Reservoir Planning. **Environmental Engineering** Water Supply-Sources-demand-treatment methods-standards.Distribution Systems-Storage-Pumping. Wastewater Engineering-Sewerage systems-sewage characteristics-treatment processes (primary to tertiary)-septic tanks.Air&Noise Pollution: Effects- control methods-monitoring.
Contact Periods: **Lecture: 15 Periods** **Tutorial: 00 Periods** **Practical: 00 Periods** **Total: 15 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the characteristics and applications of various building materials and the basic principles of structural analysis and design.	K2
CO2	Interpret geological maps, soil classification data, and surveying measurements for site assessment and planning.	K2
CO3	Apply principles of fluid mechanics to analyze flow in pipes and open channels, and describe the working of hydraulic machines.	K3
CO4	Apply transportation engineering principles in the design of highways, railways, airports, and harbour components.	K3
CO5	Explain the processes involved in water supply, wastewater treatment, and environmental pollution control systems.	K2

ASSESSMENT PATTERN – MCQ TYPE
Part A: 30 x 1= 30 marks **Part B: 35 x 2 = 70 marks** **Total = 100 marks**

22CVA$15	**Professional Skills and Career Readiness**

PREREQUISITES	CATEGORY	L	T	P	C
	EEC	0	0	2	1

Course Objectives	• To develop students' technical communication and presentation skills. • To build confidence in public speaking, group discussions, and interviews. • To improve English communication (verbal and written) for placement scenarios.

S.No	Topics / Activities	Hours
1	**Ice-breaker & Self-introductions** – Students introduce themselves, Elevator pitch	2
2	**Technical Presentations** – Students prepare a short (3-4 min) presentation on a simple technical topic	4
3	**PowerPoint / Slide Design** – Best practices, visual aids, readability	3
4	**Email Etiquette & Writing** – Structure, tone, salutations, follow-up emails	2
5	**Report Writing** – Format, structure, executive summary, technical vs business report	4
6	**Group Discussion & Debates** – Practice GD on technical/non-technical issues, role-playing, feedback	4
7	**Mock Interviews** – One-on-one and panel interviews, feedback	4
8	**Resume / CV Building** – Format, content, tailoring to job descriptions, highlighting projects	3
9	**Non-verbal Communication Skills** – Body language, posture, eye contact, voice modulation	2
10	**Reflection & Feedback -** Peer feedback, self-reflection, goal-setting for communication improvement.	2

Contact Periods:
Lecture: 00 Periods Tutorial: 00 Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Prepare and deliver technical presentations.	K3
CO2	Write professional emails, reports, and resumes.	K3
CO3	Participate in group discussions and role-plays.	K3
CO4	Demonstrate interview skills in mock scenarios.	K3
CO5	Use non-verbal communication effectively (body language, eye contact).	K3

ASSESSMENT PATTERN:
No End Semester Examination
Only Continuous Assessment

Continuous Assessment Marks distribution

1.	Presentation Assessment	25
2.	Written Assessment (Emails/report/resume)	20
3.	Mock Interview	25
4.	Participation (GDs, role-plays, and non-verbal communication)	30
	Total	**100**

22CVA$16	Placement Training

PREREQUISITES	CATEGORY	L	T	P	C
	EEC	0	0	2	1

Course Objectives	• To refine communication skills targeted at placement interviews (technical and HR). • To enhance confidence in problem-solving, aptitude, and group tasks. • To instill professional behaviour and soft skills required for workplace success.

S. No	Topics / Activities	Hours
1	**Aptitude & Reasoning Training** – Logical puzzles, quantitative reasoning	4
2	**Group Discussion** – Real-world engineering case studies, brainstorming	4
3	**Leadership & Teamwork Workshop** – Role plays, team tasks, problem solving, decision making	4
4	**Behavioural Interviews** – Common HR questions, STAR method, mock HR interview	4
5	**Technical Interviews** – Mock technical questions, peer feedback, clarity of answer.	4
6	**Personal Branding** – Crafting LinkedIn profile, writing cover letters, personal elevator pitch	4
7	**Group Exercise / Presentation** – Group presentation on a hypothetical project	4
8	**Feedback & Reflection Session** – Students reflect on their performance, set professional goals	2

Contact Periods:
Lecture: 00 Periods **Tutorial: 00 Periods** **Practical: 30 Periods** **Total: 30 Periods**

COURSE OUTCOMES: On completion of the course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Solve common aptitude and reasoning problems for placement tests.	K3
CO2	Perform well in group discussions and case-study discussions.	K3
CO3	Demonstrate leadership and teamwork in simulated workplace situations.	K3
CO4	Participate confidently in technical and HR interviews.	K3
CO5	Develop a professional portfolio (resume, LinkedIn, cover letter).	K6

ASSESSMENT PATTERN:
No End Semester Examination
Only Continuous Assessment

Continuous Assessment Marks distribution

1.	Aptitude Test	20
2.	Group Case Presentation	20
3.	Mock Interviews	25
4.	Portfolio Evaluation	25
5.	Participation & Reflection	10
	Total	**100**