R.M.K. ENGINEERING COLLEGE

RSM Nagar, Kavaraipettai-601 206, Gummidipoondi Taluk, Thiruvallur District

(An Autonomous Institution)

Affiliated to Anna University, Chennai/Approved by AICTE, New Delhi/
Accredited by NAAC with A^+ Grade/ISO 9001-2015 Certified Institution/
All Eligible UG Programs are Accredited by NBA, New Delhi

B.E. CIVIL ENGINEERING

REGULATIONS – 2020

CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

The student will be able to

I. Graduates will succeed in Civil Engineering profession and in allied Engineering fields.

II. Graduates will come out with cost effective & sustainable design of various infrastructure using modern technical tools meeting social needs.

III. Graduates will exhibit professional ethics, leadership quality, team work and adaptability to changes.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme, Engineering Graduates will be able to,

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. 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.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. 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. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. 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.

PEOs & POs

The B.E. Civil Engineering Program outcomes leading to the achievement of the objectives are summarized in the following Table.

Program Educational Objectives	**Program Outcomes**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
I	X	X	X									
II	X	X	X	X	X							X
III				X	X	X	X	X	X	X	X	X

Year	Semester	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	1	Communicative English& life skills		✓							✓	✓		✓
		Engineering Mathematics – I	✓	✓	✓	✓	✓	✓	✓					✓
		Computer aided Engineering Graphics	✓		✓		✓					✓		
		Environmental Science and Engineering	✓	✓				✓	✓			✓		✓
		Problem solving and C Programming	✓	✓	✓						✓			✓
		Basic Electrical, Electronics and Instrumentation Engineering	✓	✓	✓	✓	✓							
		Engineering Practices laboratory			✓									
		C Programming Laboratory	✓	✓	✓						✓			✓
		Interpersonal skills- Listening and speaking lab									✓	✓		✓
		Induction Program						✓	✓	✓	✓	✓	✓	✓
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
I	2	Technical English									✓		✓	✓
		Engineering Mathematics – II	✓	✓	✓	✓	✓	✓						✓
		Physics for Civil Engineering	✓	✓	✓	✓								
		Chemistry for Civil Engineering	✓	✓				✓	✓					✓
		Engineering Mechanics	✓	✓	✓									
		Building Materials	✓	✓				✓		✓				

		Physics and Chemistry Laboratory	✓	✓			✓				✓			✓
		Advanced C Programming Laboratory	✓	✓	✓					✓	✓	✓		✓
		Advanced Reading and Writing Lab									✓	✓		✓
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
II	3	Transforms and Partial Differential Equations	✓	✓	✓	✓								
		Mechanics of Materials	✓	✓	✓	✓	✓							✓
		Fluid Mechanics	✓	✓		✓		✓	✓	✓		✓		✓
		Engineering Surveying		✓	✓	✓				✓				✓
		Construction Techniques and Practices	✓	✓	✓	✓		✓	✓					
		Universal Human Values-II Understanding Harmony						✓	✓	✓	✓	✓	✓	✓
		Computer Aided Building Drawing	✓	✓	✓	✓	✓			✓	✓	✓		✓
		Surveying Laboratory		✓	✓	✓				✓		✓	✓	✓
		Design Thinking and Mini Project	✓							✓		✓		✓
		Aptitude and Coding Skills - I	✓	✓							✓	✓		
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
II	4	Numerical Methods	✓	✓	✓	✓								
		Advanced Mechanics of Materials	✓	✓	✓	✓	✓							✓
		Applied Hydraulic Engineering	✓	✓		✓		✓	✓	✓		✓		✓
		Concrete Technology	✓	✓		✓		✓	✓	✓		✓		✓
		Soil Mechanics	✓	✓				✓	✓	✓		✓		✓

		Highway and Pavement Engineering	✓	✓	✓	✓		✓	✓			✓		✓
		Strength of Materials Laboratory	✓	✓	✓	✓								✓
		Hydraulic Engineering Laboratory	✓		✓	✓	✓	✓	✓	✓		✓		✓
		Aptitude and Coding Skills - II	✓	✓							✓	✓		
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
III	5	Basic Reinforced Concrete Design	✓	✓	✓	✓	✓			✓		✓		✓
		Structural Analysis	✓	✓	✓	✓	✓			✓		✓		✓
		Environmental Engineering I			✓	✓	✓	✓	✓					✓
		Foundation Engineering		✓		✓		✓		✓				✓
		Railways, Airports, Docks and Harbour Engineering	✓	✓	✓	✓			✓					
		Professional Elective - I												
		Geotechnical Engineering Laboratory	✓		✓	✓	✓							✓
		Concrete and Highway Engineering laboratory	✓	✓		✓	✓				✓			✓
		Advanced Aptitude and Coding Skills - I	✓	✓	✓						✓	✓		
		Internship		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
III	6	Advanced Reinforced Concrete Design	✓	✓	✓	✓	✓					✓		✓
		Advanced Structural Analysis	✓	✓	✓	✓	✓			✓		✓		✓
		Environmental Engineering II			✓	✓	✓	✓	✓					✓

		Design of Steel Structures	✓	✓	✓	✓	✓			✓		✓		✓
		Professional Elective II												
		Open Elective I												
		Environmental Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
		Building Information Modelling Laboratory	✓		✓		✓			✓	✓	✓		✓
		Advanced Aptitude and Coding Skills - II	✓	✓	✓						✓	✓		
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
IV	7	Estimation, Costing and Valuation Engineering	✓	✓	✓	✓	✓			✓		✓		✓
		Water Resources and Irrigation Engineering	✓	✓	✓		✓	✓	✓					✓
		Professional elective III												
		Professional Elective IV												
		Open Elective II												
		Computer Aided Analysis, Design and Drafting Laboratory (CADD)	✓		✓	✓	✓			✓	✓	✓		✓
		Data Analysis and Programming Laboratory	✓	✓	✓		✓				✓	✓		✓
		Summer Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Year	**Semester**	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
IV	8	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

R.M.K. ENGINEERING COLLEGE
(An Autonomous Institution)

B.E. CIVIL ENGINEERING
REGULATIONS – 2020
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULUM & SYLLABI

SEMESTER I

S.No	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20EL101	Communicative English & life skills	HS	2	2	0	0	2
2.	20MA101	Engineering Mathematics – I	BS	5	3	2	0	4
3.	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
4.	20CH102	Environmental Science and Engineering	HS	3	3	0	0	3
5.	20GE101	Problem solving and C Programming	ES	3	3	0	0	3
6.	20EE101	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
PRACTICALS								
7.	20EM111	Engineering Practices laboratory	ES	4	0	0	4	2
8.	20GE111	C Programming Laboratory	ES	4	0	0	4	2
9.	20EL111	Interpersonal skills- Listening and speaking lab	HS	2	0	0	2	1
10.		Induction program	MC	3 Weeks				
			TOTAL	32	16	2	14	24

SEMESTER II

S.No	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20EL201	Technical English	HS	2	2	0	0	2
2.	20MA201	Engineering Mathematics – II	BS	5	3	2	0	4
3.	20PH201	Physics for Civil Engineering	BS	3	3	0	0	3
4.	20CH201	Chemistry for Civil Engineering	BS	3	3	0	0	3
5.	20ME205	Engineering Mechanics	ES	5	3	2	0	4
6.	20CE201	Building Materials	ES	3	3	0	0	3
PRACTICALS								
7.	20PC111	Physics and Chemistry Laboratory	BS	4	0	0	4	2
8.	20CS212	Advanced C Programming Laboratory	ES	4	0	0	4	2
9.	20EL211	Advanced Reading and Writing Lab	HS	2	0	0	2	1
			TOTAL	31	17	4	10	24

SEMESTER III

S.No	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20MA301	Transforms and Partial Differential Equations	BS	5	3	2	0	4
2.	20CE301	Mechanics of Materials	PC	5	3	2	0	4
3.	20CE302	Fluid Mechanics	PC	5	3	2	0	4
4.	20CE303	Engineering Surveying	PC	4	2	2	0	3
5.	20CE304	Construction Techniques and Practices	PC	3	3	0	0	3
6.	20GE301	Universal Human Values-II Understanding Harmony	HS	4	2	2	0	3
PRACTICALS								
7.	20CE311	Computer aided Building drawing	PC	4	0	0	4	2
8.	20CE312	Surveying Laboratory	PC	4	0	0	4	2
9.	20CE313	Design Thinking and Mini Project	EEC	2	0	0	2	1
10.	20CS313	Aptitude and Coding Skills - I	EEC	2	0	0	2	1
			TOTAL	38	16	10	12	27

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20MA403	Numerical Methods	BS	5	3	2	0	4
2.	20CE401	Advanced Mechanics of Materials	PC	4	2	2	0	3
3.	20CE402	Applied Hydraulic Engineering	PC	4	2	2	0	3
4.	20CE403	Concrete Technology	PC	3	3	0	0	3
5.	20CE404	Soil Mechanics	PC	5	3	2	0	4
6.	20CE405	Highway and Pavement Engineering	PC	3	3	0	0	3
PRACTICALS								
7.	20CE411	Strength of Materials Laboratory	PC	4	0	0	4	2
8.	20CE412	Hydraulic Engineering Laboratory	PC	4	0	0	4	2
9.	20CS414	Aptitude and Coding Skills - II	EEC	2	0	0	2	1
			TOTAL	**34**	**16**	**8**	**10**	**25**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20CE501	Basic Reinforced Concrete Design	PC	5	3	2	0	4
2.	20CE502	Structural Analysis	PC	5	3	2	0	4
3.	20CE503	Environmental Engineering- I	PC	3	3	0	0	3
4.	20CE504	Foundation Engineering	PC	4	2	2	0	3
5.	20CE505	Railways, Airports, Docks and Harbour Engineering	PC	3	3	0	0	3
6.		Professional Elective - I	PE	3	3	0	0	3
PRACTICALS								
7.	20CE511	Geotechnical Engineering Laboratory	PC	4	0	0	4	2
8.	20CE512	Concrete and Highway Engineering laboratory	PC	4	0	0	4	2
9.	20CS512	Advanced Aptitude and Coding Skills - I	EEC	2	0	0	2	1
10.	20CE513	Internship	EEC	0	0	0	0	1
			TOTAL	**33**	**17**	**6**	**10**	**26**

SEMESTER VI

S.No	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20CE601	Advanced Reinforced Concrete Design	PC	4	2	2	0	3
2.	20CE602	Advanced Structural Analysis	PC	4	2	2	0	3
3.	20CE603	Environmental Engineering II	PC	3	3	0	0	3
4.	20CE604	Design of Steel Structures	PC	5	3	2	0	4
5.		Professional Elective II	PE	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7.	20CE611	Environmental Engineering laboratory	PC	4	0	0	4	2
8.	20CE612	Building Information Modeling Laboratory	EEC	4	0	0	4	2
9.	20CS614	Advanced Aptitude and Coding Skills - II	EEC	2	0	0	2	1
			TOTAL	**32**	**16**	**6**	**10**	**24**

SEMESTER VII

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20CE701	Estimation, Costing and Valuation Engineering	PC	4	2	2	0	3
2.	20CE702	Water Resources and Irrigation Engineering	PC	3	3	0	0	3
3.		Professional elective III	PE	3	3	0	0	3
4.		Professional Elective IV	PE	3	3	0	0	3
5.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
6.	20CE711	Computer Aided Analysis, Design and Drafting Laboratory (CADD)	PC	4	0	0	4	2
7.	20CE712	Data Analysis and Programming Laboratory	EEC	4	0	0	4	2
8.	20CE713	Summer Internship	EEC	0	0	0	0	1
			TOTAL	**24**	**14**	**2**	**8**	**20**

*Course from the curriculum of other UG Programmes.

SEMESTER VIII

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	20CE811	Project Work	EEC	20	0	0	20	10
			TOTAL	20	**0**	**0**	**20**	**10**

TOTAL NO. OF CREDITS: 180

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20EL101	Communicative English & life skills	HS	2	2	0	0	2
2.	20CH102	Environmental Science and Engineering	HS	3	3	0	0	3
3.	20EL111	Interpersonal skills-Listening and speaking lab	HS	2	0	0	2	1
4.	20EL201	Technical English	HS	2	2	0	0	2
5.	20EL211	Advanced Reading and Writing Lab	HS	2	0	0	2	1
6.	20GE301	Universal Human Values-II Understanding Harmony	HS	4	2	2	0	3

BASIC SCIENCES (BS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20MA101	Engineering Mathematics – I	BS	5	3	2	0	4
2.	20MA201	Engineering Mathematics – II	BS	5	3	2	0	4
3.	20PH201	Physics for Civil Engineering	BS	3	3	0	0	3
4.	20CH201	Chemistry for Civil Engineering	BS	3	3	0	0	3
5.	20PC111	Physics and Chemistry Laboratory	BS	4	0	0	4	2
6.	20MA301	Transforms and Partial Differential Equations	BS	5	3	2	0	4
7.	20MA403	Numerical Methods	BS	5	3	2	0	4

ENGINEERING SCIENCES (ES)

S.No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20GE101	Problem solving and C Programming	ES	3	3	0	0	3
2.	20ME103	Computer Aided Engineering Graphics	ES	6	2	0	4	4
3.	20EE101	Basic Electrical, Electronics and Instrumentation Engineering	ES	3	3	0	0	3
4.	20EM111	Engineering Practices laboratory	ES	4	0	0	4	2
5.	20GE111	C Programming Laboratory	ES	4	0	0	4	2
6.	20ME205	Engineering Mechanics	ES	5	3	2	0	4
7.	20CE201	Building Materials	ES	3	3	0	0	3
8.	20CS212	Advanced C Programming Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE301	Mechanics of Materials	PC	5	3	2	0	4
2.	20CE302	Fluid Mechanics	PC	5	3	2	0	4
3.	20CE303	Engineering Surveying	PC	4	2	2	0	3
4.	20CE304	Construction Techniques and Practices	PC	3	3	0	0	3
5.	20CE311	Computer aided Building drawing	PC	4	0	0	4	2

6.	20CE312	Surveying Laboratory	PC	4	0	0	4	2
7.	20CE401	Advanced Mechanics of Materials	PC	4	2	2	0	3
8.	20CE402	Applied Hydraulic Engineering	PC	4	2	2	0	3
9.	20CE403	Concrete Technology	PC	3	3	0	0	3
10.	20CE404	Soil Mechanics	PC	5	3	2	0	4
11.	20CE405	Highway and Pavement Engineering	PC	3	3	0	0	3
12.	20CE411	Strength of Materials Laboratory	PC	4	0	0	4	2
13.	20CE412	Hydraulic Engineering Laboratory	PC	4	0	0	4	2
14.	20CE501	Basic Reinforced Concrete Design	PC	5	3	2	0	4
15.	20CE502	Structural Analysis	PC	5	3	2	0	4
16.	20CE503	Environmental Engineering, I	PC	3	3	0	0	3
17.	20CE504	Foundation Engineering	PC	4	2	2	0	3
18.	20CE505	Railways, Airports, Docks and Harbour Engineering	PC	3	3	0	0	3
19.	20CE511	Geotechnical Engineering Laboratory	PC	4	0	0	4	2
20.	20CE512	Concrete and Highway Engineering laboratory	PC	4	0	0	4	2
21.	20CE601	Advanced Reinforced Concrete Design	PC	4	2	2	0	3
22.	20CE602	Advanced Structural Analysis	PC	4	2	2	0	3
23.	20CE603	Environmental Engineering II	PC	3	3	0	0	3
24.	20CE604	Design of Steel Structures	PC	5	3	2	0	4
25.	20CE611	Environmental Engineering laboratory	PC	4	0	0	4	2
26.	20CE701	Estimation, Costing and Valuation Engineering	PC	3	2	2	0	3
27.	20CE702	Water Resources and Irrigation Engineering	PC	3	3	0	0	3
28.	20CE711	Computer Aided Analysis, Design and Drafting Laboratory (CADD)	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSETITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE313	Design Thinking and Mini Project	EEC	2	0	0	2	1
2.	20CS313	Aptitude and Coding Skills - I	EEC	2	0	0	2	1
3.	20CS414	Aptitude and Coding Skills - II	EEC	2	0	0	2	1
4.	20CS512	Advanced Aptitude and Coding Skills - I	EEC	2	0	0	2	1
5.	20CE513	Internship	EEC	0	0	0	0	1
6.	20CE612	Building Information Modelling Laboratory	EEC	4	0	0	4	2
7.	20CS614	Advanced Aptitude and Coding Skills - II	EEC	2	0	0	2	1
8.	20CE712	Data Analysis and Programming Laboratory	EEC	4	0	0	4	2
9.	20CE713	Summer Internship	EEC	0	0	0	0	1
10.	20CE811	Project Work	EEC	20	0	0	20	10

MANDATORY COURSES (MC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Induction program	MC	3 Weeks				

PROFESSIONAL ELECTIVE (PE)
SEMESTER V
ELECTIVE -I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE901	Formwork Engineering	PE	3	3	0	0	3
2.	20CE902	Engineering Hydrology	PE	3	3	0	0	3
3.	20CE903	Advanced Surveying	PE	3	3	0	0	3
4.	20CE904	Disaster management	PE	3	3	0	0	3
5.	20CE905	Housing planning and architecture	PE	3	3	0	0	3
6.	20ME926	Principles of Management	PE	3	3	0	0	3

SEMESTER VI
ELECTIVE -II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE906	Construction Planning and Scheduling	PE	3	3	0	0	3
2.	20CE907	Ground Improvement Techniques	PE	3	3	0	0	3
3.	20CE908	Maintenance, Repair and Rehabilitation of Structures	PE	3	3	0	0	3
4.	20CE909	Urban Planning and Development	PE	3	3	0	0	3
5.	20CE910	Environmental and Social Impact Assessment	PE	3	3	0	0	3
6.	20ME927	Total Quality Management	PE	3	3	0	0	3

SEMESTER VII
ELECTIVE –III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE911	Prefabricated Structures	PE	3	3	0	0	3
2.	20CE912	Prestressed Concrete Structures	PE	3	3	0	0	3
3.	20CE913	Computer Aided Design of Structures	PE	3	3	0	0	3
4.	20CE914	Building services	PE	3	3	0	0	3
5.	20CE915	Industrial structures	PE	3	3	0	0	3
6.	20CE916	Finite Element analysis	PE	3	3	0	0	3
7.	20CE917	Professional Ethics in Engineering	PE	3	3	0	0	3

ELECTIVE –IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE918	Fundamentals of Structural dynamics	PE	3	3	0	0	3
2.	20CE919	Groundwater Engineering	PE	3	3	0	0	3
3.	20CE920	Water Resources Systems Engineering	PE	3	3	0	0	3
4.	20CE921	Bridge Engineering	PE	3	3	0	0	3
5.	20CE922	Municipal solid waste management	PE	3	3	0	0	3
6.	20CB404	Introduction to Innovation, IP Management and Entrepreneurship	PE	3	3	0	0	3

OPEN ELECTIVES (OE)

(Offered to other Departments)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CE001	Climate Change and its Impact	OE	3	3	0	0	3
2.	20CE002	Green Building Design	OE	3	3	0	0	3
3.	20CE003	Geographic Information System	OE	3	3	0	0	3
4.	20CE004	Air Pollution and Control Engineering	OE	3	3	0	0	3
5.	20CE005	Waste Water Treatment	OE	3	3	0	0	3

OPEN ELECTIVES (OE)

(Requested from other Departments)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CS001	Python Programming	OE	3	3	0	0	3
2.	20EC001	Sensors and Transducers	OE	3	3	0	0	3
3.	20EC002	MATLAB Programming	OE	3	3	0	0	3
4.	20ME001	Introduction to Nanotechnology	OE	3	3	0	0	3
5.	20CS002	Software Engineering	OE	3	3	0	0	3
6.	20IT002	Artificial Intelligence and Machine Learning	OE	3	3	0	0	3
7.	20CS005	Internet of Things	OE	3	3	0	0	3
8.	20ME006	Testing of Materials	OE	3	3	0	0	3

SUMMARY

S.No	Subject Area	Proposed Credits per Semester								Total credits
		1	2	3	4	5	6	7	8	
1	HS	6	3	3						12
2	BS	4	12	4	4					24
3	ES	14	9							23
4	PC			18	20	21	15	8		82
5	PE					3	3	6		12
6	OE						3	3		6
7	EEC			2	1	2	3	3	10	21
8	MC									-
Total		24	24	27	25	26	24	20	10	180

HUMANITIES AND SOCIAL SCIENCES (HS) / BASIC SCIENCES (BS) / ENGINEERING SCIENCES (ES) / PROFESSIONAL CORE (PC) / PROFESSIONAL ELECTIVES (PE) / OPEN ELECTIVES (OE) / EMPLOYABILITY ENHANCEMENT COURSES (EEC) / MANDATORY COURSES (MC)

SYLLABUS

SEMESTER - I

20EL101	COMMUNICATIVE ENGLISH & LIFE SKILLS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The Course will enable learners to:

- Strengthen their basic reading and writing skills.
- Comprehend listening contexts competently.
- Improve their speaking skills to speak fluently in real contexts.
- Develop vocabulary of a general kind and enhance their grammatical accuracy.

UNIT I COMMUNICATION BASICS 06

Listening - short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information. Reading - practice in skimming - scanning and predicting. Writing-completing sentences - developing hints- free writing – Everyday expressions- collocations. Life Skills - Overview of Life Skills: significance of life skills.

UNIT II COMMUNICATION INTERMEDIATE 06

Listening- telephonic conversations. **Speaking** – sharing information of a personal kind —greeting – taking leave. **Reading** – short comprehension passages - pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions / open-ended questions) - **Writing** – paragraph writing- topic sentence - main ideas, short narrative descriptions using some suggested vocabulary and structures. **Life skills** – Self-awareness: definition, need for self-awareness; Coping with Stress and Emotions.

UNIT III COMMUNICATION VANTAGE 06

Listening – listening to longer texts and filling up the table - **Speaking**- asking about routine actions and expressing opinions. **Reading**- Long texts (cloze reading) - **Writing**- jumbled sentences - product description - use of reference words and discourse markers. Grammar – Tenses - phrasal verbs - Wh – Questions, yes or no questions and direct / indirect questions – countable & uncountable nouns – modal verbs. **Life skills** – Assertiveness vs Aggressiveness

UNIT IV SYNERGISTIC COMMUNICATION 06

Listening - listening to dialogues or conversations and completing exercises based on them - **Speaking**- speaking about oneself- speaking about one's friend – **Reading** - different types of texts- magazines - **Writing** - letter writing, informal or personal letters - e-mails-conventions of personal email - Language development - synonyms – antonyms. **Life Skills** –Problem Solving Techniques.

UNIT V COMMUNICATION HIGHER 06

Listening – listening to TED talks - **Speaking** – role play – **Reading** - Biographies – **Writing**- writing short essays (analytical & issue-based essays) – dialogue writing. **Life Skills** – Leadership & Decision making.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Read articles of a general kind in magazines and newspapers efficiently and identify different life skills.

CO2 Participate efficiently in informal conversations and develop an awareness of the self

and apply well-defined techniques to cope with emotions and stress.

CO3 Comprehend conversations and short talks delivered in English.

CO4 Write short essays of a general kind and personal letters and emails in English.

CO5 Develop vocabulary of a general kind by enriching their reading skills.

CO6 Use appropriate thinking and problem- solving techniques to solve new problems.

TEXTBOOKS:

1. Kumar, Suresh E and Sreehari, P. Communicative English. Orient Black Swan, 2007.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP,2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.
3. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
4. Larry James, The First Book of Life Skills; First Edition, Embassy Books, 2016.
5. Larsen, Kristine, Stephen Hawking: A Biography, Greenwood: Publishing Group,2005.
6. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student 's Book & Workbook) Cambridge University Press, New Delhi: 2005.

20MA101	**ENGINEERING MATHEMATICS–I**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

OBJECTIVES:

The syllabus is designed to:

- Explain the concepts of matrix algebra.
- Make the students understand the idea of curvature, evolutes and envelopes.
- Impart the knowledge of functions of several variables.
- Introduce the concepts of Gamma and Beta integral.
- Develop an understanding on the basics of multiple integrals.

UNIT I MATRICES **9+6**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II APPLICATIONS OF DIFFERENTIAL CALCULUS **9+6**

Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes (excluding Evolute as envelope of normals).

UNIT III FUNCTIONS OF SEVERAL VARIABLES **9+6**

Limits – Continuity – Partial derivatives (excluding Euler's theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV GAMMA, BETA INTEGRALS AND APPLICATIONS **9+6**

Gamma and Beta Integrals – Properties – Relation between Gamma and Beta functions, Evaluation of integrals using Gamma and Beta functions.

UNIT V MULTIPLE INTEGRALS **9+6**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Diagonalize a matrix by orthogonal transformation.
CO2 Determine the Evolute and Envelope of curves.
CO3 Examine the maxima and minima of function of several variables.
CO4 Apply Gamma and Beta integrals to evaluate improper integrals.
CO5 Evaluate the area and volume by using multiple integrals.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
3. T. Veerarajan, “Engineering Mathematics”, Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

REFERENCES:

1. M. K. Venkataraman, “Engineering Mathematics, Volume I”, 4th Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, “Engineering Mathematics”, Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, ”Higher Engineering Mathematics”, S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, “Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

20ME103 COMPUTER AIDED ENGINEERING GRAPHICS

L	T	P	C
2	0	4	4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

UNIT I INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CAD COMMANDS **18**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to CAD commands- CAD user interface- coordinate systems, object selection methods, selection of units and precession. Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer. Conversion of simple pictorial diagrams to orthographic view using CAD software

UNIT II PLANE CURVES 16

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

UNIT III PROJECTION OF POINTS, LINES AND PLANE SURFACES 18

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

UNIT IV PROJECTION OF SOLIDS AND PROJECTION OF SECTIONED SOLIDS 20

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method. Sectioning of above solids 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 V DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION 18

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

TOTAL: 90 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Illustrate the fundamentals and standards of engineering drawing and apply the concepts of orthographic projections using CAD software.
- **CO2** Interpret and construct various plane curves.
- **CO3** Develop orthographic projections of points, lines and plane surfaces.
- **CO4** Make use of concepts in projection to draw projections of solids and interpret the concept in section of solids.
- **CO5** Interpret and visualize development of surfaces.
- **CO6** Interpret and visualize development of surfaces.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 15th Edition, 2019.

REFERENCES:

1. Bhatt N.D. "Engineering Drawing", Charotar Publishing House, 53rd edition 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2019.
3. Engineering Drawing Practice for Schools and Colleges BIS SP46:2003 (R2008), Published by Bureau of Indian Standards (BIS), 2008.
4. Parthasarathy. N.S and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2019.

5. Gopalakrishna. K.R., Engineering Drawing Vol 1 & 2, Subhas Publications, 27th Edition, 2017.

20CH102	ENVIRONMENTAL SCIENCE AND ENGINEERING (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

The goal of this course is to enlighten and sensitize the students on environmental conservation and social issues. The course is designed to:

- Appreciate the natural resources of environment which are inherently created for supporting life.
- Learn scientific and technological solutions to current day pollution issues.
- Study the interrelationship between living organisms and environment
- Understand the integrated themes of biodiversity.
- Appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I NATURAL RESOURCES 11

Introduction - scope and importance of environment – need for public awareness.

Forest resources- Use and over-exploitation, deforestation - timber extraction, mining, dams and their effects on forests and tribal people. **Water resources** - Use and over- utilization of surface and ground water, conflicts over water, dams-benefits and problems. **Mineral resources**- Use and exploitation, environmental effects of extracting and using mineral resources. **Food resources**- World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources** - Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. **Land resources**- Land as a resource, land degradation, soil erosion and desertification – role of an individual in conservation of natural resources - case studies.

UNIT II POLLUTION AND ITS MANAGEMENT 11

Pollution – causes, effects and control measures - Air pollution- Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards - nuclear accidents and holocaust - role of an individual in prevention of pollution – case studies.

Waste management - causes, effects and control measures of municipal solid wastes, e- waste, plastic waste.

UNIT III ECOSYSTEMS AND BIODIVERSITY 9

Introduction to ecosystems – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids - types, characteristic features, structure and functions of - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (lakes, oceans)

Introduction to biodiversity – types (genetic, species and ecosystem diversity) –values of biodiversity – threats to biodiversity - endangered and endemic species – conservation of biodiversity (in-situ and ex-situ conservation) - India as a mega-diversity nation – hot-spots of biodiversity in India.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

Sustainable development – sustainable development goals - water conservation, rain water harvesting, watershed management – resettlement and rehabilitation - consumerism and waste products, value education.

Disaster management- floods, drought, earthquake, tsunami, cyclone and landslides - case studies.

Environmental ethics- issues and possible solutions – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Introduction - population growth, variation among nations, population explosion, family welfare programme – women and child welfare - environment and human health – endemic/epidemic/pandemic, COVID – 19, HIV / AIDS– role of information technology in environment and human health –environmental impact assessment- case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Illustrate the importance and conservation of natural resources.

CO2 Assess the impact of various pollutants and suggest appropriate pollution control methods.

CO3 Explain the basic structure of ecosystem and the conservation of biodiversity.

CO4 Analyze the social issues related to environment and recommend suitable solutions.

CO5 Investigate the trends in population explosion and assess its impact.

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik, "Perspectives in environmental studies", New Age International, 6th edition, 2018.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M. Masters, Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2015.

REFERENCES:

1. William P. Cunningham and Mary Ann Cunningham, "Environmental Science: A Global Concern", McGraw Hill, 14th edition, 2017.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd., Delhi, 14th edition, 2014.
3. Erach Bharucha, "Textbook of Environmental Studies", Universities Press Pvt. Ltd., Hyderabad, 2nd edition, 2015.

20GE101	PROBLEM SOLVING AND C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students understand the fundamentals of problem-solving using Algorithm and Flowchart
- To teach the basic programming constructs for solving simple problems
- To introduce the basic concepts of arrays and strings
- To acquaint the students about functions, pointers, structures and their relationship
- To impart knowledge on the concepts of file handling

UNIT I INTRODUCTION TO ALGORITHM AND C 9

Introduction to Computer System – Block diagram, Program Development Life Cycle

General problem-Solving concepts: Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Imperative languages: Introduction to imperative language, syntax and constructs of a specific language (ANSI C), Applications

Types, Operators: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Basic I/O using scanf, printf, Operators – Types, Precedence, Associativity, Proper variable naming and Hungarian Notation.

UNIT II CONTROL FLOW STATEMENTS 7

Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming.

UNIT III ARRAYS AND FUNCTIONS 10

Arrays and Strings – Initialization, Declaration – One Dimensional and Two-Dimensional arrays – Linear search, Binary Search, Matrix Operations (Addition and Subtraction)

Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types.

UNIT IV STRUCTURES AND POINTERS 10

Basic Structures, Structures and Functions, Array of structures.

Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

Pointer of structures, Self-referential structures, Table look up, typedef, unions, Bit-fields

UNIT V FORMATTED I/O AND FILE PROCESSING 9

Formatted Output – fprintf, Formated Input – fscanf, Variable length argument list

Files - file access including FILE structure, fopen, fread, fwrite, stdin, sdtout and stderr, File Types – Text, Binary - Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Develop algorithmic solutions to simple computational problems
- **CO2** Develop simple applications using basic constructs
- **CO3** Write programs using arrays and strings
- **CO4** Design and implement applications using functions, pointers and structures.
- **CO5** Design applications using sequential and random-access file processing.

TEXTBOOKS:

1.Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.

2.Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCES:

1.B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018

2.Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017

3.Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.

4.Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2018.

5.Zed A. Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)", (Zed Shaw's Hard Way Series), 1st Edition, Addison-Wesley Professional, 2015.

20EE101	BASIC ELECTRICAL, ELECTRONICS & INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- Basics of DC and AC Electrical circuits
- Principle of operation of Electrical Machines
- Operation of Electron Devices
- Design Concept of Digital Circuits
- Working principle of measuring instruments and transducers

UNIT I ELECTRICAL CIRCUITS **9**

Basic circuit components -, Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits.

UNIT II ELECTRICAL MACHINES **9**

Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines, three phase and single phase induction motors.

UNIT III ELECTRONIC DEVICES AND CIRCUITS **9**

Introduction –Characteristics of PN junction Diode-Zener effect-Zener Diode and its characteristics-Half wave and Full Wave Rectifiers- Voltage Regulation-Bipolar Junction Transistor – Characteristics – Field Effect Transistors – Transistor Biasing –Introduction to operational Amplifier –Inverting Amplifier –Non Inverting Amplifier

UNIT IV DIGITAL ELECTRONICS **9**

Binary number system-Boolean algebra theorems- Digital Circuits-Introduction to sequential circuits-Flip flops- Registers and counters- ADC-DAC

UNIT V MEASUREMENTS & INSTRUMENTATION 9

Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical-Classification of instruments - Types of indicating Instruments - multimeters –Oscilloscopes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1** Analyze the DC and AC electrical circuits and its components using fundamental laws.
- **CO2** Analyze the performance characteristics of electrical machines.
- **CO3** Design rectifiers and amplifiers using semiconductor devices and IC's.
- **CO4** Design and analyze the digital logic circuits and converters
- **CO5** Choose suitable transducers for measuring specific physical quantities
- **CO6** Select appropriate indicating instrument for measuring electrical quantities

TEXTBOOKS:

1.S.K. Bhattacharya, "Basic Electrical & Electronics Engineering", Pearson Education.

REFERENCES:

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016

20EM111	**ENGINEERING PRACTICES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 15

Buildings:

(a) Study of plumbing and carpentry components of residential and industrialbuildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewageworks.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Woodwork, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **15**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metalarc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending.Example Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step conepulley.

(c) Fitting: Exercises – Preparation of square fitting and V – fittingmodels.

COURSE OUTCOMES:

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

CO1 Develop carpentry components and pipe connections including plumbing works.

CO2 Make use of welding equipments to join the structures

CO3 Analyse the basic machining operations

CO4 Develop the models using sheet metal works

CO5 Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings

CO6 Fabricate carpentry components and pipe connections including plumbing works.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE **15**

1. Study of various safety measures in Electrical System
2. Draw and demonstrate the layout for a residential house wiring using energy meter, switches, fuse, indicator, LED lamp, fluorescent lamp with one of the lamps to be controlled by 2 different switches
3. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit (series and parallel circuit).

4. Measurement of energy using single phase energy meter for incandescent lamp and LED lamp.
5. Measurement of resistance to earth of an electrical equipment

IV ELECTRONICS ENGINEERING PRACTICE **15**

1. Study of Electronic components (fixed and Variable):
   i. Resistor – Measurement of resistance using colour coding and digital multimeter.
   ii. Capacitor – Measurement of capacitance using identification code, LQR meter
   iii. Inductor – Measurement of inductance using colour coding and LQR meter
2. Study of Electronic equipment:
   i. Signal generation using AFO (sine, square, triangle for various frequency and amplitude ranges)
   ii. Measurement of amplitude, frequency, peak-peak, RMS, period, DC level of sine, square and triangle waveform using CRO and DSO.
   iii. Measurement of DC voltage and current using analog and digital meters
3. Study of Electronic accessories:
   i. Circuit connection using Breadboard and wires.
   ii. Circuit connection using general purpose PCB by Soldering practice techniques.
4. Study of logic gates AND, OR, EX-OR and NOT.
5. Generation of Clock Signal.
6. Measurement of ripple factor of HWR and FWR.
7. Study of Iron box, fan and regulator (resistive and electronics type), emergency lamp, Power Tools: (a) Range Finder (b) Digital Live-wire detector

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Carry out simple wiring as per the layout given.

CO2 Measure various electrical parameters like voltage, current, power factor, power, energy, resistance to earth etc.

CO3 Calculate ripple factor for a waveform and use logic gates for simple applications

TOTAL: 60 PERIODS

(Part A:30 periods and Part B: 30 periods)

20GE111	**C PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

- To make the students write simple programs using basic constructs
- To familiarize the concepts of strings, pointers, functions and structures
- To equip the students on the knowledge of file processing concepts

LIST OF EXPERIMENTS:

1. Constructing Flow charts using RAPTOR tools.
2. Programs using I/O statements and expression
3. Write a program to find whether the given line is horizontal or vertical.
4. Write a program to calculate the distance between two points p1(x1,y1), p2(x2,y2).

5. Write a program to calculate the force for the given mass and acceleration.
6. Write a program to calculate the young's modulus.
7. Write a program to calculate the type of solution based on its pH value.
8. Write a program to temperature conversion (Fahrenheit to Celsius and vice versa)
9. Programs using decision-making constructs.
10. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example, 1700, 1800 and 1900 is not a leap year)
11. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
12.Check whether a given number is Armstrong number or not?
13.Given a set of numbers like, find sum of weights based on the following conditions.

- 5 if it is a perfect cube.
- 4 if it is a multiple of 4 and divisible by 6.
- 3 if it is a prime number.

Sort the numbers based on the weight in the increasing order as shown below
<10, its weight>, <36, its weight>, <89, its weight>
14. Populate an array with height of persons and find how many persons are above the average height.
15. Populate a two-dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
16. Given a string ―a$bcd./fg‖ find its reverse without changing the position of special characters.(Example input:a@gh%;j and output:j@hg%;a)
17. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
18. From a given paragraph perform the following using built-in functions:

a. Find the total number of words.
b. Capitalize the first word of each sentence.
c. Replace a given word with another word.

19. Solve towers of Hanoi using recursion.
20. Sort the list of numbers using pass by reference.
21. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:

EID, Ename, Designation, DOB, DOJ, Basicpay
Note that DOB and DOJ should be implemented using structure within structure.

22. Compute internal marks of students for five different subjects using structures and functions.
23. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
24. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
25. Mini project: Create a ―Railway reservation system with the following modules

- Booking
- Availability checking
- Cancellation
- Prepare chart

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 Write programs for simple applications making use of basic constructs, arrays and strings.

CO2 Develop programs involving functions, recursion, pointers, and structures.

CO3 Create applications using sequential and random-access file processing.

TEXT BOOKS:

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCE BOOKS:

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.
4. Reema Thareja, "Programming in C", 2nd Edition, Oxford University Press, 2018.
5. Zed A. Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)", (Zed Shaw's Hard Way Series), 1st Edition, Addison-Wesley Professional, 2015.

20EL111	INTERPERSONAL SKILLS (LISTENING & SPEAKING) LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Equip and strengthen the English language skills.
- Provide guidance and practice to engage in specific academic speaking activities and enhance
- writing skills with specific reference to technical writing (interview skills).
- Improve general and academic listening skills.
- Demonstrate their presentation skills competently.

UNIT I **6**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics - taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II **6**

Listen to a process information- give information, as part of a simple explanation – conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III **6**

Deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail.

UNIT IV **6**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and participating in conversations.

UNIT V **6**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course Learners will be able to:

CO1 Listen and respond appropriately.

CO2 Participate in group discussions.

CO3 Make effective presentations.

CO4 Participate confidently and appropriately in conversations both formal and informal.

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
4. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

SEMESTER – II

20EL201	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

OBJECTIVES:

The Course prepares second semester Engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Demonstrate their speaking skills to make technical presentations, participate ingroup discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I INTRODUCTION - TECHNICAL ENGLISH 6

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing**- purpose statements – extended definitions - writing instructions – checklists – recommendations-Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 6

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** - describing a process-**Reading**– reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 6

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- Vocabulary Development-sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 6

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- Report Writing (accident and survey) - minutes of a meeting - Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development-reported speech.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 6

Listening- TED talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– email etiquette- job application – cover letter –Résumé preparation (via email and hard copy)- Vocabulary Development- verbal analogies - Language Development- clauses- if conditionals.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course learners will be able to:

CO1 Read technical texts and write area- specific texts effortlessly.

CO2 Listen and comprehend lectures and talks in their area of specialization successfully.

CO3 Speak appropriately and effectively in varied formal and informal contexts.

CO4 Write reports and winning job applications.

TEXTBOOKS:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.

2. Sudharshana.N.P and Saveetha C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1.Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.

2. Herbert, A. J. The Structure of Technical English.Longman.1976.

3. Kumar, Suresh. E. Engineering English. Orient Black swan: Hyderabad,2015.

4. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning, USA: 2007.

5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.

20MA201	**ENGINEERING MATHEMATICS–II**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

OBJECTIVES:

The syllabus is designed to:

- Explain various techniques in solving ordinary differential equations.
- Make the students understand the concepts of vector differentiation and integration.
- Introduce the concepts of Laplace transforms and its applications.
- Develop an understanding on analytic function, conformal mapping and complex integration.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+6

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+6

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Statement only) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III LAPLACE TRANSFORMS 9+6

Laplace transforms – 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 transform – Convolution theorem (Statement only) – Initial and final value theorems – Solution of linear ordinary differential equation of second order with constant coefficients using Laplace transformation techniques.

UNIT IV COMPLEX DIFFERENTIATION AND CONFORMAL MAPPING 9+6

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (Statement only) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z + k$, kz, $1/z$, $z2$ and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+6

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Statement and applications of Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1 Solve the higher order linear differential equations.

CO2 Determine the gradient of a scalar field, divergence and curl of a vector fields and interpret their physical meaning and evaluate line, surface and volume integrals by vector integration.

CO3 Apply Laplace Transforms method for solving linear ordinary differential equation.

CO4 Construct an analytic function and analyze conformal mapping.

CO5 Evaluate the real integrals using complex integration.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

REFERENCES:

1. M. K. Venkataraman, "Engineering Mathematics, Volume II", 4th Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, "Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

20PH201	PHYSICS FOR CIVIL ENGINEERING (For B.E. - Civil Engineering)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to Civil Engineering.
- To learn the fundamental concepts of physics and to apply these fundamental principles to solve both scientific problems related to materials and for engineering applications.

UNIT I WAVES AND OSCILLATIONS 9

Motion- Translational motion- Rotational motion- Torsional pendulum: theory and experiment - Periodic motion- Oscillatory motion- Simple Harmonic motion- Differential equation of SHM - Forced and damped oscillations: Differential Equation and its solutions- Plane progressive waves - Wave equations.

UNIT II LASER AND FIBRE OPTICS 9

Lasers: population of energy levels - Einstein's A and B coefficients -Derivation -Resonant cavity - Optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction.

Fibre optics: principle, numerical aperture and acceptance angle - Types of optical fibres (material, refractive index, and mode) -Losses associated with optical fibres - Fibre optic sensors: pressure and displacement.

UNIT III PROPERTIES OF MATTER 9

Elasticity- Hooke's law -Stress–strain diagram - Poisson's ratio - Factors affecting elasticity - Mechanical properties of materials - Strength, stiffness, hardness, malleability, ductility, creep, fatigue - Bending moment - Depression of a cantilever - Young's modulus by uniform and non-uniform bending- I-shaped girders.

UNIT IV THERMAL PHYSICS 9

Transfer of heat energy - Thermal expansion of solids and liquids - Expansion joints - Bimetallic strips -Thermal conduction, convection and radiation -Heat conductions in solids -Thermal conductivity - Forbe's and Lee's disc methods: theory and experiment -Conduction through compound media (series and parallel) -Thermal insulation - Applications: Heat exchangers – Refrigerator - Solar water heater.

UNIT V ACOUSTICS 9

Classification of sound-Decibel- Weber–Fechner law - Sabine's formula- derivation using growth and decay method - Absorption Coefficient and its determination - Factors affecting acoustics of buildings and their remedies - Methods of sound absorption -Sound absorbing materials - Noise and its measurements -Sound insulation and its measurements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course, the students will be able to gain basic knowledge and good understanding on the following topics.

- **CO1** To recognize and apply the basic knowledge of waves and oscillations.
- **CO2** To know the principle, construction and working of lasers and their applications in fibre optic communication.
- **CO3** To comprehend the concepts of elastic properties of materials and properties of matter.
- **CO4** To apply the knowledge of thermal properties and its applications.
- **CO5** To classify sound and analyze the factors affecting the acoustics of buildings.
- **CO6** To understand the basic concepts of waves and oscillations, laser and fiber optics, elastic and thermal properties of materials and acoustics.

TEXTBOOKS:

1. M.N. Avadhanulu and P.G. Kshirsagar, "A text book of Engineering Physics", S. Chand and Company, New Delhi, 2014.
2. A. Marikani, "Engineering Physics", PHI Learning Private Limited, Second Edition, 2013.
3. V. Rajendran, "Materials Science", Tata McGraw-Hill, 2011.
4. K.G.Budinski and M.K.Budinski, "Engineering Materials Properties and Selection", Prentice Hall, 2009.
5. B.J.Smith,"Acoustics and Noise control", Longman,1996.

6. A.L. Stanford, J.M. Tanner, “Physics for students of science and engineering”, Academic Press, Elsevier, 1985.

REFERENCES:

1. D. Halliday, R. Resnick and J. Walker, “Fundamentals of Physics”, 9thEdition., John Wiley & sons, 2011.
2. Richard P. Feynman, “The Feynman Lectures on Physics - Vol. I, II and III”, The New Millennium Edition, 2012.
3. Wole Soboyejo, “Mechanical Properties of Engineered Materials”, Marcel Dekker Inc., 2003.
4. Alberto Sona, “Lasers and their Applications”, Gordon and Breach Science Publishers Ltd., 1976.

20CH201	CHEMISTRY FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The goal of this course is to achieve conceptual understanding of the applications of chemistry in the field of civil engineering. The syllabus is designed to:

- Be conversant with hardness of water, its implications in boilers and water treatment techniques.
- Acquire basic knowledge on polymers, its classification and their applications in construction industry.
- Impart knowledge on the basics of corrosion, its types and corrosion control methods.
- Acquaint the students with building materials like cement, lime and glass.
- Develop an understanding on the basics of different types of engineering materials.

UNIT I WATER TECHNOLOGY 9

Hardness of water – types –expression of hardness – units – estimation of hardness of water by EDTA method – numerical problems - boiler troubles (scale and sludge formation, priming and foaming, boiler corrosion, caustic embrittlement) – treatment of boiler feed water - internal treatment (colloidal, phosphate, calgon) – external treatment (zeolite, demineralization) – desalination of brackish water (reverse osmosis) - qualities of drinking water –domestic water treatment.

UNIT II POLYMERS 9

Introduction – monomer, functionality, degree of polymerization – classification based on source and applications – effect of polymer structure on properties- types of polymerizations- addition, condensation, copolymerization - thermoplastics and thermosetting resins – preparation, properties and applications of Teflon, polyvinyl chloride, polycarbonate, phenol-formaldehyde – natural rubber- vulcanization of rubber, applications of polymers in construction industry.

UNIT III CORROSION AND ITS CONTROL 10

Corrosion – causes of corrosion – principles of chemical corrosion – Pilling–Bedworth rule – principles of electrochemical corrosion – differences between chemical and electrochemical corrosion – factors influencing corrosion – types of corrosion – galvanic corrosion, differential aeration corrosion, pitting corrosion, waterline corrosion, stress corrosion.

Corrosion control – cathodic protection – sacrificial anodic protection – selection of materials and

proper designing – corrosion inhibitors- protective coatings – paints – constituents – functions – special paints – fire retardant, water repellant, temperature indicating paints.

UNIT IV CHEMISTRY OF BUILDING MATERIALS 8

Cement – chemical composition –manufacture of Portland cement- setting and hardening - special cements – high alumina cement, sorel cement, white cement, waterproof cement.

Lime – manufacture, setting and hardening.

Glass – manufacture of glass by tank furnace – special glasses- tempered glass, laminated glass, chromatic glass, glass wool.

UNIT V ENGINEERING MATERIALS 9

Refractories- characteristics-classification- properties – refractoriness, RUL, dimensional stability, thermal spalling, thermal expansion, porosity- manufacture of refractories (general method).

Adhesives- classification based on origin- adhesive action – development of adhesive strength – factors influencing adhesive action- advantages and limitations.

Composites –characteristics – constituents of composites – types – polymer matrix composites (PMC), metal matrix composites (MMC), ceramic matrix composites (CMC) – FRP -properties and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

- **CO1** Classify the potential impact of impurities in water for industrial and domestic use.
- **CO2** Apply the basic knowledge on different polymeric materials, their general preparation methods and their applications in the construction industry.
- **CO3** Compare and contrast different corrosion types and to discuss various corrosion control techniques.
- **CO4** Explain manufacturing of building materials like cement, lime and glass and their properties.
- **CO5** Describe the properties and uses of engineering materials such as refractories, adhesives and composites.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2018.
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India Pvt. Ltd., Delhi, 2015.

REFERENCES:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", 12th edition, S. Chand & Company, New Delhi, 2010.
2. V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar, 2nd edition, "Polymer Science", New Age International Pvt. Ltd., New Delhi, 2005.
3. J. C. Kuriacose and J. Rajaram, "Chemistry in Engineering and Technology", Volume-1 & Volume -2, Tata McGraw-Hill Education Pvt. Ltd., 2010.

20ME205	ENGINEERING MECHANICS	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES 9+6

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+6

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

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

Centroids and Centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 9+6

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

UNIT V FRICTION AND RIGID BODY DYNAMICS 9+6

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1	Illustrate the vectorial and scalar representation of forces and moments
CO2	Analyze the rigid body in equilibrium
CO3	Evaluate the properties of surfaces and solids
CO4	Apply dynamic forces exerted in rigid body
CO5	Solve the friction and the effects by the laws of friction
CO6	Apply the effort of force and moment in the various design functions of rigid body

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 12th Edition, Tata McGraw-Hill Publishing company, New Delhi (2019).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2019)

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 2019.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 14th Edition, Pearson Education 2017.
3. Meriam J.L. and Kraige L.G., "Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", 8th Edition, John Wiley & Sons,2018.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2017.

20CE201	BUILDING MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide exposure on the selection and properties of different building materials used for various civil engineering applications

UNIT I MASONRY MATERIALS 9

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Concrete blocks – Lightweight concrete blocks.

UNIT II BINDING MATERIALS AND AGGREGATES 9

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand - M sand and P sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading.

UNIT III CONCRETE – TIMBER – STEEL 10

Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Timber – Defects in timber – Market forms – Industrial timber– Plywood – Veneer –Steel – Making – Types and Properties – Market forms – Aluminum and Other Metallic Materials – Composition – Mechanical treatment.

UNIT IV BUILDING FINISHES AND INSULATION MATERIALS 9

Paints – Varnishes – Distempers – Bitumen – Insulating materials and its benefits – Types and uses – Selection – factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort – Fire proofing materials. definition and classification – Fiber reinforced plastics (FRP) and fiber reinforced metals (FRM) – Metallic glasses.

UNIT V MODERN MATERIALS 9

Composite materials — Shape memory alloys – Glass – Properties and Types – Modern floor finishing materials – Ceramics and Clay products – Polymer floor finishes – Water proofing materials.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

- **CO1** Apply the knowledge for the selection of different materials used for masonry.
- **CO2** Compare the properties of various binding materials and aggregates.
- **CO3** Understand the various applications of concrete, timber and steel.
- **CO4** Identify the various building finishes.
- **CO5** Understand the importance of thermal insulation in buildings.
- **CO6** Discover the applications of modern building materials.

TEXT BOOKS:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K. "Building Materials", 4th Edition, New Age International, 2008.

REFERENCES:

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3. W.D. Callister, "Materials Science and Engineering: An introduction", John Wiley, 1994.
4. V. Raghavan,"Materials Science and Engineering", Prentice Hall, 1990.
5. M.F.Ashby and D.R.H. Jones, "Engineering Materials 1: An introduction to their properties & applications", Butterworth Heinemann, 2003.
6. R.M.E. Diamant, "Thermal and Acoustic Insulation-1st Edition", Butterworth-Heinemann.
7. Jens Holger Rindel, "Sound insulation in buildings", CRC Press; 1st Edition (October 31, 2017)
8. IS 456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011.
9. IS 4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012.
10. IS 383 - 1970: Indian Standard specification for coarse and fine aggregate from natural sources for concrete, 2011.
11. IS 1542-1992: Indian standard specification for sand for plaster, 2009.

20PC111	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

(Common to all branches of B.E. / B. Tech Programmes except for CSBS)

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter, semiconductors and liquids.

LIST OF EXPERIMENTS (Any five experiments to be conducted)

1. Determination of wavelength and velocity of ultrasonic waves by Ultrasonic Interferometer.
2. Determination of thermal conductivity of a poor conductor by LEE'S Disc method.
3. (i) Determination of wavelength and divergence angle of semiconductor laser source using diffraction grating.
   (ii) Determination of particle size by using diffraction of semiconductor laser beam.
   (iii) Analysis of Numerical aperture and acceptance angle of an optical fibre.

4. Determination of Young's Modulus of a beam by non-uniform bending method.
5. Determination of the moment of inertia of the disc and rigidity modulus of wire by Torsional pendulum.
6. Spectrometer - Determination of wavelength of Mercury Spectrum using diffraction grating.
7. Determination of thickness of wire by air wedge method.
8. Determination of Young's Modulus of a beam by Uniform bending method.
9. Determination of band gap of a semiconductor.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, based on hands-on experience of the students, they will be able to

CO1 use the ultrasonic interferometer and to determine the wavelength and velocity of ultrasonic waves of a liquid.

CO2 examine the thermal conductivity of a bad conductor.

CO3 determine the wavelength of mercury spectrum and also determine the wavelength of a laser source, particle size, divergence angle of semiconductor laser source using diffraction grating and to analyze the numerical aperture and acceptance angle of an optical fibre.

CO4 examine the Young's modulus of a beam by uniform and non-uniform bending and to estimate the moment of inertia of the disc and rigidity modulus of wire by torsional pendulum.

CO5 calculate the thickness of a thin wire by the interference pattern.

CO6 determine the band gap of a semiconductor.

REFERENCES

1. Physics laboratory manual, Department of Physics, R.M.K. Engineering college, 2019.
2. Wilson J.D. and Hernandez C.A., - Physics Laboratory Experiments, Houghton Mifflin Company, New York, 2005.

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the students acquire practical skills through volumetric and instrumental analysis.

LIST OF EXPERIMENTS

1. Determination of total, temporary and permanent hardness of water by EDTA method.
2. Conductometric titration of strong acid vs. strong base.
3. Determination of strength of acids in a mixture using a conductivity meter.
4. Determination of strength of given hydrochloric acid using a pH meter.
5. Estimation of the iron content of the given solution using a potentiometer.
6. Estimation of the iron content of the water sample using a spectrophotometer (thiocyanate method).
7. Estimation of sodium present in water using a flame photometer.
8. Determination of the molecular weight of polyvinyl alcohol using Ostwald viscometer.
9. Determination of corrosion rate by weight loss method.
10. Determination of flash and fire point of a lubricating oil (Pensky Martens apparatus).
11. Determination of concentration of a given solution by constructing a galvanic cell.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Based on hands-on experience, students will be able to:

CO1	Analyse the given hard water sample and estimate different types of hardness present.
CO2	Observe and analyse the change in conductivity of an acid(s) when added with base through conductometry.
CO3	Examine the change in pH when an acid is added with a base using pH meter.
CO4	Understand the redox reactions and its impact on emf values through potentiometry.
CO5	Determine the flash and fire point of an oil.
CO6	Assess the corrosion rate of a given metal.
CO7	Construct an electrochemical cell to determine the concentration of the given solution.

REFERENCES:

1. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", 6th edition, Pearson Education Pvt. Ltd., 2009.

20CS212	ADVANCED C PROGRAMMING LABORATORY (Common to Civil, EEE, EIE, Mech)	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop programs using Arrays and Strings
- To develop programs using pointers and dynamic memory allocation
- To develop programs using files
- To apply C programming for solving Engineering Problems

LIST OF EXPERIMENTS

1. Array Manipulation
2. String Manipulation
3. Pointers
4. Solving polynomial equations
5. Dynamic Memory Allocation
6. File Manipulation
7. Domain specific problems
8. Study on performance characteristics of Reciprocating pump.

INDICATIVE LIST OF EXERCISES:

1. **Arrays:**
   a) Find the prime factors of a number.
   b) Find maximum repeating number.
   c) Find k^{th} smallest element in an unsorted array.
   d) Matrix manipulation – Addition, Subtraction, Multiplication.
   e) Job Sequencing: Given an array of jobs where every job has a deadline and a profit. Profit can be earned only if the job is finished before the deadline. It is also given that every job takes a single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time. Print the sequence of jobID order to maximize total profit.

2. **String Manipulation:**
   a) Find the frequency of all the characters in a string.
   b) Given two strings S1 and S2. Remove all the occurrences of S2 in S1 and print the remaining.
   c) Reversing a set of words.
   d) Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.

3. **Pointers:**
   a) Manipulating two dimensional arrays using pointers.
   b) Print the odd positioned characters and then even positioned characters using pointers.
   c) Programs using double pointers in C.
   d) Print all permutations of a given string using pointers.
4. **Numerical Solutions of Polynomials**
   a) Solve a polynomial equation.
   b) Find the value of the derivative of the polynomial equation given by the user who provides the value of the unknown variable x.
5. **Dynamic Memory Allocation:**
   a) Find Largest Number Using Dynamic Memory Allocation.
   b) Print the list of elements in reverse order.
6. **File Manipulation:**
   a) Merge the content of two files.
   b) Merge two lists given.
   c) Print the odd positioned characters from a file content.
7. **Solve domain specific problems in C:**

   Civil
   1) Find the area of the irregular land using Trapezoidal rule.
   2) Find the area of the irregular land using Simpson rule.

   EEE & EIE
   1) Find the current through a resistor, for voltage varying from 5V to 20V in steps of 5V, using Ohm's Law.
   2) Find equivalent resistance when resistors are connected in series, equivalent capacitance when capacitors are connected in parallel.

   Mechanical
   1) Compute the volume of solids (prism, pyramids, cylinder and cone) from Engineering Graphics problems.
   2) Draw a projectile from Engineering mechanics problems.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Apply array and string concepts to solve problems.

CO2 Employ pointers to solve various problems.

CO3 Implement dynamic memory allocation.

CO4 Understand file manipulations.

CO5 Design and develop real-world applications utilizing the concepts of arrays, strings, pointers, dynamic memory allocation and files.

20EL211	ADVANCED READING AND WRITING LAB	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Strengthen their reading skills.
- Enhance writing skills with specific reference to technical writing.
- Apply their critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT -I **6**

Reading - Strategies for effective reading - Writing -Write a descriptive paragraph - Predicting content using photos and title.

UNIT- II **6**

Reading - Use of graphic organizers to review and aid comprehension. Writing - Write an opinion paragraph

UNIT -III **6**

Reading - speed reading techniques - Writing - Elements of a good essay- Analytical Essay.

UNIT -IV **6**

Reading - Genre and Organization of Ideas – Writing - Email writing - Job application

UNIT- V **6**

Reading - Critical reading and thinking -Writing - letter of recommendation - Vision statement

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Write different types of essays.
CO2 Write winning job applications.
CO3 Read and evaluate texts critically.
CO4 Display critical thinking in various professional contexts.

TEXT BOOKS:

1. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011.
2. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011.

REFERENCES:

1. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006.
2. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
3. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012.
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000.
5. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004.
6. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004.

SEMESTER – III

20MA301	TRANSFORMS & PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	2	0	4

OBJECTIVES:

The syllabus is designed to:

- illustrate the concepts and techniques of Fourier series.
- discuss the concepts of Fourier transforms and Z-transforms
- describe the solutions of partial differential equations
- formulate and solve the boundary value problems.

UNIT I FOURIER SERIES **15**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range expansions – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS **15**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III Z – TRANSFORMS AND DIFFERENCE EQUATIONS **15**

Z-transforms – Elementary properties – Inverse Z-transforms (method of partial fraction and residues) – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS **15**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations – Lagrange's linear equation — homogenous and non-homogeneous linear partial differential equations of second and higher order with constant coefficients.

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **15**

Classification of PDE – Method of separation of variables – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (excluding insulated edges).

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Employ the Fourier series concept in Engineering Problems.
CO2 Identify the solution of Fourier transform in continuous time signals
CO3 Elucidate the difference equation using Z-transform.
CO4 Compute the solutions of the partial differential equation.
CO5 Utilize the Fourier series for heat and wave equations.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.
2. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers New Delhi, 2017.

REFERENCES:

1. N.P. Bali, and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd, 2007.

2. B.V. Ramana, “Higher Engineering Mathematics”, 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. C. Ray Wylie and L.C. Barrett, “Advanced Engineering Mathematics” 6th Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
5. K.B. Datta, “Mathematical Methods of Science and Engineering”, 1st Edition, Cengage Learning India Pvt Ltd, Delhi, 2013.

20CE301	MECHANICS OF MATERIALS	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To obtain conceptual knowledge on stress, strain and deformation of solids on axially loaded prismatic and composite members.
- To understand the concept of shear force, bending moment and determination of deflection on beams due to transverse loading.
- To learn the effect of torsion on shafts and springs and to analyze plane and space trusses.

UNIT I STRESS AND STRAIN AND DEFORMATION OF SOLIDS 12

Stresses and strains – Tension, compression, shear – Hooke’s Law – Relationship between elastic constants – Stress strain diagram for Mild Steel, TOR steel, concrete – Ultimate stress – Yield stress – Factor of safety – Deformation of axially loaded member – Uniaxial, biaxial and triaxial state of stress- Composite bars - Thermal stresses – Stresses on inclined planes – Principal stresses and principal planes - Mohr's circle method.

UNIT II BENDING OF BEAMS 15

Types of beams, supports, loads – Concept of shear force and bending moment – Relationship between intensity of load, shear force and bending moment - Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams with all different types of loads - Theory of simple bending – Bending stress and shear stress distribution across various sections for all determinate beams - Analysis of flitched beams.

UNIT III DEFLECTION OF BEAMS 11

Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

UNIT IV TORSION AND SPRINGS 11

Elastic theory of torsion – Torsion of circular and hollow circular shafts – Stresses and deflection in circular solid and hollow shafts – Combined bending moment and torsion of shafts - Strain energy due to torsion - Modulus of rupture – Power transmitted to shaft – Shaft in series and parallel – Closed and open coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs.

UNIT V ANALYSIS OF TRUSSES 11

Types of trusses – assumptions - Analysis of pin jointed plane trusses by method of joints, method of sections and tension coefficient – Analysis of space trusses.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Understand the concepts of stress and strain in prismatic and composite bars, thermal stresses, principal stresses and principal planes.
- **CO2** Determine Shear force, bending moment and bending stress distribution across various sections of beams based on theory of simple bending.
- **CO3** Analyze flexural members for shear stress distribution across various sections.
- **CO4** Determine slope and deflection of determinate beams using different methods.
- **CO5** Apply theory of torsion in design of circular shafts and helical springs.
- **CO6** Analyze pin jointed plane and space trusses using different methods.

TEXTBOOKS:

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2018.
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials, Laxmi publications. New Delhi, 2018.

REFERENCES:

1. Timoshenko.S.P. and Gere.J.M, "Mechanics of Materials", Van Nos Reinbhold, New Delhi 2018.
2. Singh. D.K., "Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016.
3. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2017.
4. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 2016.

20CE302	FLUID MECHANICS	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To introduce about properties of the fluids, behaviour of fluids under static, kinematic and dynamic conditions.
- To impart basic knowledge about dimensional analysis and model studies.
- To understand and analyze the complexities involved in solving fluid flow problems.

UNIT I FLUID PROPERTIES AND FLUID STATICS 12

Fluid – distinction between solid and fluid - Units and dimensions - Properties of fluids - **Fluid statics:** concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers - forces on planes – buoyancy and floatation.

UNIT II FLUID KINEMATICS AND DYNAMICS 12

Fluid Kinematics: Classification of flows - velocity field and acceleration - continuity equation - stream line-streak line-path line- stream function - velocity potential function - flow net.

Fluid Dynamics: Equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - venturi meter, orifice meter and pitot tube- linear momentum equation and its application to pipe bend.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 12

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

UNIT IV FLOW THROUGH PIPES 12

Reynold's experiment - laminar flow through pipes - Hagen Poiseuille's equation – turbulent flow

through pipes - Darcy - Weisbach's equation - Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel - Equivalent pipes.

UNIT V BOUNDARY LAYER 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Demonstrate the difference between solid and fluid, its properties and behavior in static conditions.
- **CO2** Apply the conservation laws applicable to fluids through fluid kinematics and dynamics.
- **CO3** Relate the parameters involved in the given fluid phenomenon and predict the performances of prototype by model studies.
- **CO4** Estimate losses in pipelines for both laminar and turbulent conditions.
- **CO5** Analyze flow through pipes connected in series and in parallel.
- **CO6** Explain the concept of boundary layer and its application to find the drag force exerted by the fluid on the flat solid surface.

TEXT BOOKS:

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2018.
2. Bansal. R. K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd., New Delhi, 2018.
3. Jain. A. K.., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, 2016.
4. Rajput. R. K. "Fluid Mechanics", S. Chand and Co, New Delhi, 2019.

REFERENCES:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 2017.
2. Fox W.R. and McDonald A.T., "Introduction to Fluid Mechanics", John-Wiley and Sons, Singapore, 2019.
3. White, F.M., "Fluid Mechanics", Tata McGraw Hill, New Delhi, 2017.
4. Subramanya. K "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

20CE303	**ENGINEERING SURVEYING**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

OBJECTIVES:

- To provide an understanding on the principles, methods and applications of plane surveying.
- To familiarize the field procedures, measurement techniques and equipment used in geodetic surveying for mapping the topography.
- To impart knowledge on the concepts of space-based positioning system, hydrological and astronomical surveying.

UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELLING 10

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Bearing - Levelling- Principles and

theory of Levelling – Datum - Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling- Booking and Reduction– Curvature and refraction - Contour – Uses and Characteristics of contours – Methods of contouring – Contour gradient.

UNIT II THEODOLITE AND TACHEOMETRIC SURVEYING 9

Horizontal and vertical angle measurements - Temporary and permanent adjustments – Heights and distances - Trigonometrical levelling – single and reciprocal observations –Tacheometer - Stadia Constants - Anallactic Lens -Tangential and Stadia Tacheometric surveying.

UNIT III CONTROL SURVEYING AND ADJUSTMENT 9

Horizontal and vertical control – specifications – triangulation- baseline – satellite stations – reduction to centre- traversing – Gale's table - Error sources– classification of errors – true and most probable values – principle of least squares - normal equation – correlates- adjustment of simple triangulation networks.

UNIT IV HYDROGRAPHIC AND ASTRONOMICAL SURVEYING 9

Hydrographic Surveying – Tides – MSL – Sounding methods – Three-point problem - Astronomical Surveying – Astronomical terms - Motion of sun and stars – Celestial coordinate systems - different time systems - Nautical Almanac - Field observations and determination of time, longitude, latitude and azimuth by altitude and hour angle method.

UNIT V TOTAL STATION AND GPS SURVEYING 8

Total Station: Parts and accessories - Fundamental quantities measured – working principle – Field procedure and applications - Errors and Good practices in using Total Station- GPS: System components – Signal structure – Selective availability and anti-spoofing – receiver components and antenna – Planning and data acquisition – Data processing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Summarize the procedure for measuring 2-D Cartesian coordinates, horizontal angle and vertical angles using various instruments for engineering projects.
- **CO2** Apply the principle of levelling to compute orthometric heights relative to a vertical survey datum with different instruments.
- **CO3** Identify solutions for erroneous measurements of a survey network.
- **CO4** Describe the methods of sounding techniques conducted during hydrographic surveys.
- **CO5** Determine the absolute position of any object on the earth's surface to various celestial bodies.
- **CO6** Outline the concept, principles and applications of advanced data capturing methods using total station and GPS.

TEXTBOOKS:

1. Kanetkar. T. P and Kulkarni.S.V, "Surveying and Levelling: Part 1 & 2", Pune Vidyarthi Griha Prakashan, Pune, 2010.
2. Punmia. B. C., Ashok K. Jain and Arun K Jain, "Surveying Vol. I, II & III", Lakshmi Publications Pvt Ltd, New Delhi, 2016.

REFERENCES:

1. Satheesh Gopi, R.Sathikumar, N. Madhu, "Advanced Surveying, Total Station, GPS, GIS and Remote Sensing" Pearson education, 2018.
2. Alfred Leick, "GPS Satellite Surveying", John Wiley & Sons, Inc., 4th Edition, 2015.
3. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2010.
4. Arora K.R., "Surveying Vol I & II", Standard Book house, 12th Edition 2013.

20CE304	CONSTRUCTION TECHNIQUES AND PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on the various construction techniques, practices and the equipment needed for different types of construction activities.
- To establish an understanding about the various construction procedures from substructure to super structure.
- To provide exposure on all the real time practices involved in the construction industry.

UNIT I CONSTRUCTION TECHNIQUES 9

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

UNIT II CONSTRUCTION PRACTICES 9

Specifications, details and sequence of activities – Construction co-ordination – Site Clearance – Marking – Earthwork – brick masonry – stone masonry – concrete hollow block masonry – flooring – damp proof courses – construction joints, movement and expansion joints – pre cast pavements – Building foundations – basements – temporary shed – centering and shuttering – slip forms – scaffoldings – de-shuttering forms – Fabrication and erection of steel trusses – frames – braced domes – roof finishes – acoustic and fire protection - Introduction to Construction management software – MS Project.

UNIT III SUB STRUCTURE CONSTRUCTION 9

Techniques of Box jacking – Pipe Jacking - under water construction: diaphragm walls, sheet piles and basements -Tunneling techniques – Piling techniques –caisson wells –cofferdams – cable anchoring and grouting – shoring for deep cutting – Dewatering and standby plant equipment for underground open excavation.

UNIT IV SUPER STRUCTURE CONSTRUCTION 9

Launching girders, bridge decks, off shore platforms – special forms for shells – techniques for heavy decks – in-situ prestressing in high rise structures, Material handling – erecting light weight components on tall structures – Support structure for heavy Equipment and conveyors – Erection of articulated structures, braced domes and space decks.

UNIT V CONSTRUCTION EQUIPMENT 9

Selection of equipment for earth work – earth moving operations – types of earthwork equipment – tractors, motor graders, scrapers, front end loaders, earth movers – Equipment for foundation and pile driving. Equipment for compaction, batching, mixing and concreting – Equipment for material handling and erection of structures – types of cranes – Equipment for dredging, trenching, tunneling.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Differentiate the Structural Systems, including construction methods of various structures.

CO2 Summarize various techniques and practices involved in construction of masonry

structures.

CO3 Suggest the various techniques for substructure construction.

CO4 Explain the methods and techniques involved in the construction of various types of super structures.

CO5 Discuss the selection and usage of various equipment in each stage of construction.

CO6 Identify the recent advancements in techniques involved in construction.

TEXTBOOKS:

1. Arora S.P. and Bindra S.P., "Building Construction", Dhanpat Rai and Sons, 2018.

2. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 2019.

3. Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, Second edition, 2017.

REFERENCES:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", 9th Edition, McGraw Hill, Singapore, 2018.

2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers New Delhi, 6th edition 2008.

3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2017.

20GE301	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	C
		2	2	0	3

OBJECTIVES:

The objective of the course is fourfold:

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

COURSE TOPICS:

The course has 28 lectures (2 lecture hours) and 14 practice sessions (2 Tutorial hour) in 5 Units:

UNIT I COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal HumanValues-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for

living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF!

7.Understanding human being as a co-existence of the sentient 'I' and the material 'Body'

8.Understanding the needs of Self ('I') and 'Body' - happiness and physical facility

9.Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

10.Understanding the characteristics and activities of 'I' and harmony in 'I'

11.'Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail

12.Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III SUB STRUCTURE CONSTRUCTION

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship

14. Understanding the meaning of Trust; Difference between intention and competence

15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institutes extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

18. Understanding the harmony in the Nature

19. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature

20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHIC

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

25. Competence in professional ethics: a. Ability to utilize the professional competence for

augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems.

27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students

- **CO1** would become more aware of themselves, and their surroundings (family, society, nature);
- **CO2** would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
- **CO3** would have better critical ability.
- **CO4** Would become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- **CO5** would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
- **CO6** Identify the recent advancements in techniques involved in construction.

TEXTBOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks, NewDelhi, 2010

REFERENCES:

1.Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

3.The Story of Stuff (Book).

4.The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

5.Small is Beautiful-E. F Schumacher.

6.Slow is Beautiful-Cecile Andrews

7.Economy of Permanence - J C Kumarappa

8.Bharat Mein Angreji Raj – Pandit Sunderlal

9.Rediscovering India – by Dharampal

10.Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

11.India Wins Freedom – Maulana Abdul Kalam Azad

12.Vivekananda-Romain Rolland (English)

13.Gandhi-Romain Rolland (English)

20CE311	COMPUTER AIDED BUILDING DRAWING	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To provide knowledge on symbols and sign conventions used in building drawing.
- To enable the students to create plan, elevation and sectional views of buildings manually and using drafting software.
- To impart knowledge on execution of plan in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.

LIST OF EXPERIMENTS

A. Manual drafting:

1. Drafting of plan, elevation and sectional views for the given specification of a single storey residential building.
2. Planning a building for a given area.

B. AutoCAD drawing:

3. Introduction to Drafting and Annotation commands.
4. Principles of planning, orientation and complete joinery details (Paneled and Glazed Doors and Windows)
5. Plotting of plan, elevation and sectional views for the given specifications of:
   i. Single Floor Residential building.
   ii. Buildings with load bearing walls.
   iii. Buildings with sloping roof.
   iv. R.C.C. framed structures.
   v. Industrial buildings – North light roof structures.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Plan a building according to the requirements of National Building Code.
CO2	Prepare the layout and sectional views of a building manually.
CO3	Apply the AUTOCAD commands to generate different views of joinery details.
CO4	Draft the plan, elevation and sectional views of the given structure using AUTOCAD.
CO5	Utilize the knowledge on the usage of modern tools.
CO6	Develop technical communication skill in the form of communicative drawing.

TEXTBOOKS:

1. Sikka. V. B., A Course in Civil Engineering Drawing,5th Edition, S. K. Kataria and sons, 2021.
2. George Omura, Brian C. Benton, "Mastering AutoCAD 2019 and AutoCAD LT2019", Wiley – An Autodesk Official Press, 2019.

REFERENCES:

1. Shah M.G. Kale C.M. & Patki S.Y., "Building Drawing with an Integrated Approach to Built Environment", 6th edition, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2019.
2. Verma.B.P., Civil Engineering Drawing and House Planning, Khanna Publishers, 11th edition 2016.

20CE312	SURVEYING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To acquire practical knowledge on handling basic and advanced survey instruments.
- To conduct field survey professionally according to the principles of plane and geodetic surveying.
- To understand the principles and applications of different instruments to solve engineering problems.

LIST OF EXPERIMENTS:

1. Determine the area of a boundary by chain survey.
2. Setting out works – Foundation marking for given plan of a building.
3. Conducting a Closed traverse of a given area using prismatic compass and plotting after adjustment.
4. Determination of elevation of various points with dumpy level by height of collimation method and rise & fall method.
5. Fixing bench mark with respect to a temporary bench mark with dumpy level by fly levelling and check levelling.
6. Measurements of horizontal angles and vertical angles using theodolite.
7. Determination of elevation of an object using single plane method when base is accessible.
8. Determination of height of an object whose base is inaccessible (single plane method - instrument axes at different levels).
9. Determination of Tacheometric Constants.
10. Determination of Heights and distances using stadia Tacheometry.
11. Determination of Heights and distances by Tangential Tacheometry.
12. Run a closed traverse using Total station and plotting the traverse.
13. Determination of distance and difference in elevation between two inaccessible points using Total station.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Interpret survey data to compute area and volume.

CO2 Infer the plan of a building and transfer a building layout to the field.

CO3 Measure Horizontal angle and vertical angle using different instruments.

CO4 Construct a level circuit and obtain Reduced Levels of various Points on the surface of the earth with respect to specific datum or Bench Mark.

CO5 Record geodetic data and perform analysis for survey problems using electronic instruments.

CO6 Develop communication skills, including those involved in working in groups.

REFERENCES:

1.Punmia.B.C., Ashok K.Jain and Arun K Jain, “Surveying Vol. I, II & III”, Lakshmi Publications Pvt. Ltd, New Delhi, 2016

2.NITTTR, Chennai Educational Videos:
https://www.youtube.com/channel/UCpjtGnHYmoG77IBMjvdo7aw

Virtual Lab:

IIT Roorkee:

http://sl-iitr.vlabs.ac.in/sl-iitr/List%20of%20experiments.html?domain=Civil%20Engineering

20CE313	DESIGN THINKING AND MINI PROJECT	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To use the fundamental knowledge gained in Civil Engineering to carry out a project, which allows the students to come up with design and fabrication.
- To encourage the usage of coding skill in the development of project.
- To enable the students to find solutions to societal problems expressing their ideas in a novel way.

STRATEGY:

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Apply fundamental engineering knowledge to the identified problem.
CO2	Analyze and design the technical aspects of the project with comprehensive and systematic approach using new technology.
CO3	Develop projects with sustainability, understanding the societal and environmental importance.
CO4	Work as an individual or as a team in development of technical projects.
CO5	Comprehend and write reports effectively on the project related activities and findings.
CO6	Apply ethical principles in all the stages of the project and explore its advancements.

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1	**Internal Marks:** (Decided by conducting 3 reviews by the project committee formulated by the department)	**60 marks**
2	**Viva voce examination:** (Evaluated by the internal examiner appointed by the COE with the approval of HOD) a. Project report : 20 marks (Every student belonging to the same group gets the same mark) b. Presentation/demonstration/ viva-voce : 20 marks	**40 marks**

20CS313	APTITUDE AND CODING SKILLS – I (Common to All Branches)	L 0	T 0	P 2	C 1

OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

List of Exercises:

1. English – Phase I

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I

Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Develop vocabulary for effective communication and reading skills.

CO2 Build the logical reasoning and quantitative skills.

CO3 Develop error correction and debugging skills in programming.

SEMESTER – IV

20MA403	NUMERICAL METHODS	L	T	P	C
		3	2	0	4

OBJECTIVES:

The syllabus is designed to:

- develop the skills of solving algebraic, transcendental and the system of equations using various methods.
- determine the interpolation in various intervals by numerical techniques.
- compute the differentiation and integration by numerical techniques.
- illustrate the various techniques of solving ordinary differential equations and partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 15

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method.

UNIT II INTERPOLATION AND APPROXIMATION 15

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 15

Single step methods – Taylor's series method – Euler's method – Modified Euler's method –Fourth order Runge-Kutta method for solving first order equations – Multi step methods – Milne's and Adam's-Bashforth predictor and corrector methods for solving first order equations – Finite difference methods for solving second order – two-point linear boundary value problems.

UNIT V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 15

Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Compute the solutions of algebraic, transcendental and the system of equations.

CO2 Implement the numerical techniques of interpolation in equal and unequal intervals.

CO3 Apply the numerical techniques of differentiation and integration for engineering problems.

CO4 Employ the various techniques and methods for solving first and second order ordinary Differential equations.

CO5 Solve the partial differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS:

1. R.L. Burden, and J.D. Faires, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. B.S. Grewal, and J.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. J.H. Mathews, "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. K. Sankara Rao, "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. S.S. Sastry, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

20CE401	ADVANCED MECHANICS OF MATERIALS	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To introduce the concepts of energy principles for determination of slope and deflection.
- To learn the concept of analysis of indeterminate beams and different types of columns.
- To obtain conceptual knowledge on three-dimensional state of stress and unsymmetrical bending and various theories of failure.

UNIT I ENERGY PRINCIPLES 9

Strain energy and modulus of resilience – Strain energy due to axial load (gradual, sudden and impact loadings), shear, flexure and torsion – Castigliano's theorems – Maxwell's reciprocal theorem - Principle of virtual work – Unit load method - Application of energy theorems for computing deflections in determinate beams, frames and trusses.

UNIT II INDETERMINATE BEAMS 9

Concept of Analysis - Propped cantilever, fixed and continuous beams - Fixed end moments and reactions – Shear force and bending moment diagrams - Theorem of three moments – analysis of continuous beams– Sinking of supports.

UNIT III COLUMNS AND CYLINDERS 10

Short and long columns - Euler's column theory – critical load for prismatic columns with different end conditions – Effective length – limitations - Rankine-Gordon formula - Eccentrically loaded columns – middle third rule - core of a section – Thin cylindrical and spherical shells – stresses and change in dimensions - Thick cylinders – Compound thick cylinders – Thick spherical shells.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 9

Stress tensor - Spherical and deviatoric components – Stress invariants - Determination of principal stresses and principal planes - Volumetric strain. Theories of failures: Rankine's theory, Coulomb's theory or Guest's theory, St. Venant's theory, Haigh's theory, Von Mises- Hencky theory.

UNIT V ADVANCED TOPICS IN BENDING 8

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Analysis of curved beams – Winkler Bach formula.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Determine the strain energy and deflection of beams, frames and trusses using energy principles.
- **CO2** Analyze propped cantilever, fixed beams and continuous beams and draw shear force and bending moment diagrams.
- **CO3** Determine the load carrying capacity of long and short columns and stresses in thin cylinders, thick cylinders and spherical shells.
- **CO4** Determine principal stresses and principal planes in three-dimensional state of stress.
- **CO5** Apply various failure theories to determine the critical stress which governs the design.
- **CO6** Analyze the stresses due to unsymmetrical bending of beams and the stresses in curved beams.

TEXTBOOKS:

1.Rajput R.K. "Strength of Materials (Mechanics of Solids)", S. Chand & company Ltd., New Delhi, 2015.
2.Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017.
3.Ramamrutham S. and R. Narayanan "Strength of Materials", Dhanpat Rai Publishing Co Pvt. Ltd. 2014.

REFERENCES:

1.Timoshenko. S. P and D. H. Young "Elements of strength of Materials", East West, India 2018.
2.Junnarkar. S.B. and Shah. H. J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 2016.
3.Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2017.
4.N. Krishna Raju, "Advanced Mechanics of Solids and Structures", Tata McGraw-Hill Publishing Co., New Delhi, 2018.

20CE402	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To impart basic knowledge about the open channel flows with analysis of uniform flow, gradually varied flows and rapidly varied flows.
- To give exposure on the working principle and design of Pelton wheel, Francis and Kaplan turbines.
- To familiarise the working principles of Centrifugal and Reciprocating pumps.

UNIT I UNIFORM FLOW 10

Definition and differences between pipe flow and open channel flow - Types and regimes of flow - Properties of open channel - Velocity distribution in open channel - Steady uniform flow: Chezy's equation, Manning's equation - Most economical sections for uniform flow – Wide open channel - Specific energy and specific force.

UNIT II GRADUALLY VARIED FLOW 9

Dynamic equations of gradually varied flows – Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination – Graphical integration, Direct step and Standard step method.

UNIT III RAPIDLY VARIED FLOW 8

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Celerity – Surges and surge through channel transitions.

UNIT IV TURBINES 9

Classification of Turbines – Pelton wheel – Francis turbine – Kaplan turbine - Specific speed – Performance of turbine - Characteristic Curves - Draft tube - Cavitation.

UNIT V PUMPS 9

Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - Multistage pumps – Characteristics curves - Reciprocating pumps - Negative slip - Indicator diagrams and its variations – Air vessels - Savings in work done.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Identify different regimes of flow, analysis of uniform flow in steady state conditions with specific energy concept and its application.
- **CO2** Identify the most economical section for flow in different channel sections.
- **CO3** Analyse steady and gradually varied flow, water surface profiles and its length calculation using direct and standard step methods.
- **CO4** Differentiate the types of hydraulic jumps and estimating energy loss in hydraulic jump with exposure to positive and negative surges.
- **CO5** Design turbines and explain the working principle with characteristic curves.
- **CO6** Differentiate pumps and explain the working principle with characteristic curves.

TEXTBOOKS:

1.Subramanya. K, "Flow in open channels", Tata McGraw Hill, Fifth Edition, New Delhi, 2019.
2.Modi P.N and Seth. S.M "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2019.
3.Chandramouli P.N., "Applied Hydraulic Engineering", Yes Dee Publishing Pvt. Ltd., 2017.

REFERENCES:

1.Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
2.Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi, 2014
3.Jain.A.K., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, 2016.
4.Subramanya.K., "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2018.

20CE403	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview of the fundamental concepts and understanding of the behavioral aspects of various materials in Concrete making, Special concretes and Concreting methods.
- To provide exposure on the various methods of mix design for concrete.
- To impart knowledge on the testing of fresh and hardened concrete including NDT techniques.

UNIT I CONSTITUENT MATERIALS 9

Cement - Different types - Chemical composition and Properties - Hydration of cement - Tests on cement - IS Specifications - Aggregates - Classification - Mechanical properties and tests as per BIS - Grading requirements – Water - General requirements - Tolerable concentrations of impurities - Quality of water for use in concrete - Use of sea water and its effects.

UNIT II CHEMICAL AND MINERAL ADMIXTURES 9

Accelerators - Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Rice Husk Ash, Silica Fume, Micro and Nano Silica, Ground Granulated Blast Furnace Slag and Metakaoline - Effects on concrete properties.

UNIT III PROPORTIONING OF CONCRETE MIX 9

Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - Design practice of ACI - BIS Method of Mix Design - Examples - Concrete Mix Design in Excel sheet.

UNIT IV FRESH AND HARDENED PROPERTIES OF CONCRETE 9

Workability - Tests for workability of concrete - Segregation and Bleeding - Determination of strength Properties of Hardened concrete - Compressive strength - Split tensile strength - Flexural strength - Stress-strain curve for concrete - Modulus of elasticity – Durability of concrete - Water absorption – Permeability - Corrosion test - Acid resistance - NDT- Rebound Hammer test - Ultrasonic Pulse Velocity method.

UNIT V SPECIAL CONCRETES AND CONCRETING METHODS 9

Light weight and Heavy weight concrete - High strength and High-performance concrete - Self compacting concrete - Fiber reinforced concrete - Polymer and Geopolymer concrete - Ferrocement - Special concreting methods: Ready mix concrete - Under-water concreting - Guniting and shotcreting - Waterproofing methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Describe the requirements of cement, aggregates and water for making concrete.

CO2 Summarize the effect of admixtures on properties of concrete.

CO3 Apply the concept of mix proportioning using different mix design methods.

CO4 Classify the properties of concrete at fresh and hardened state.

CO5 Explain the importance and application of special concretes.

CO6 Identify and carry out tests relevant to the use of concrete on site.

TEXT BOOKS:

1.Shetty. M. S, A. K. Jain, "Concrete Technology - Theory and Practice", S. Chand and Company Ltd, New Delhi, 8th Edition, 2019.

2.Bhavikatti. S. S, "Concrete Technology", I. K. International Publishing House Pvt. Ltd., New Delhi, 2015.

3.Gupta. B.L., Amit Gupta, "Concrete Technology", Standard Publishers Distributors, New Delhi, 4th Edition, 2014.

REFERENCES:

1.Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2nd Edition, 2018.

2.Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995.

3.Gambhir, M.L; "Concrete Technology–Theory and Practice", 5th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2014.

4.IS 456: 2000, Code of Practice for Plain and Reinforced Concrete.

5.IS 10262: 2009, Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

6.ACI 211.1-91 - ACI Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete, 2002.

20CE404	SOIL MECHANICS	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To impart knowledge on the soil classification and familiarize Engineering problems related to permeability, seepage and compressibility.
- To provide an understanding on the stress on foundation loads including appropriate shear strength parameters with respect to the drainage conditions.
- To familiarize the students about the methods of assessing stability of both infinite and finite slopes.

UNIT I SOIL CLASSIFICATION AND COMPACTION 12

Historical development of Soil Mechanics - Origin and Major soil deposits of India - Soil structure and clay minerals-Three phase system- Phase relationship - Index Properties- Field identification and IS classification of soils - Compaction –Laboratory and field compaction methods – Factors influencing compaction- Effect of compaction on engineering properties of soils.

UNIT II EFFECTIVE STRESS AND PERMEABILITY 12

Types of soil water- Concept of effective and neutral stresses- Capillarity in soils- Permeability- Darcy's law -Laboratory and field permeability methods - Factors influencing permeability of soils- Permeability of stratified soils- Seepage flow - Laplace's equation – Properties and uses of flow nets – Simple problems- Quick sand condition.

UNIT III STRESS DISTRIBUTION AND SETTLEMENT 12

Vertical stress distribution in soil - Boussinesq and Westergaard's equation - Newmark's influence chart - Pressure bulb - Contact pressure distribution in sands and clays. - Compressibility and consolidation – Pressure void ratio relationship- Terzaghi's one dimensional consolidation theory - Total settlement and time rate of settlement - Coefficient of consolidation - Curve fitting methods - Preconsolidation pressure and its determination.

UNIT IV SHEAR STRENGTH 12

Shear strength - Sources of shear strength- Mohr-Coulomb failure criterion - Use of Mohr's circle - Relationship between principal stresses and shear parameters- Measurement of shear strength- Direct shear test, triaxial shear test, unconfined compression test and vane shear test– Factors affecting shear strength of granular and cohesive soils- Pore pressure parameters.

UNIT V SLOPE STABILITY 12

Types of slopes – Types of slope failures – Infinite slopes – Total stress analysis, Swedish Circle method and Friction circle method- Determination of centre of most critical slip circle – Taylor's stability charts and their use – Slope protection measures.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Characterize and Classify soils.

CO2 Interpret the role of water in soil behaviour and evaluation of geostatic stresses, permeability and quantity of seepage.

CO3 Explain the stress distribution under applied loads.

CO4 Analyze and compute the consolidation settlements.

CO5 Identify the shear strength parameters for field conditions.

CO6 Assess the stability methods of both finite and infinite slopes.

TEXT BOOKS:

1.Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).

2.Gopal Ranjan and A.S.R. Rao, A.S.R "Basic and Applied Soil Mechanics" Wiley Eastern Ltd., New Delhi, Third Edition 2016.

3.Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.

4.Venkatramaiah C., "Geotechnical Engineering ", New Age International Publishers, Sixth Edition, 2018.

REFERENCES:

1.Braja M. Das, "Principles of Geotechnical Engineering". Cengage Learning India Private Limited, 8th Edition, 2014.

2.Criag, "Soil Mechanics" - CRC Press, 2012.

3.David F. Mc. Carthy, "Essentials of Soil Mechanics and Foundations – Basic Geotechnics" Pearson Publications., New Delhi, 2015.

4.Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, "Geotechnical Engineering Principles and Practices", PHI Learning Private limited, 2011.

5.Palanikumar. M., "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited Delhi, 2013.

6.Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.

7.Purushothama Raj. P., "Soil Mechanics and Foundations Engineering", 2nd Edition, Pearson Education, 2013.

8.Narsinga Rao, B.N.D. "Soil Mechanics and Foundation Engineering" Wiley India Pvt. Ltd. New Delhi, 2015.

20CE405	HIGHWAY AND PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the various factors and significance on highway planning, alignment and geometrical elements.
- To give an overview about pavement design, construction and maintenance practices as per IRC standards.
- To provide knowledge on quality assessment, functional and structural evaluation of the pavements.

UNIT I HIGHWAY PLANNING, ALIGNMENT AND CLASSIFICATION 8

History of road development in India - Significance of highway planning - Highway alignment - factors influencing highway alignment - Engineering surveys for alignment, objectives, conventional and modern methods - Classification of highways - Locations and functions - Typical cross sections of Urban and Rural roads.

UNIT II GEOMETRIC DESIGN OF HIGHWAYS 9

Cross sectional elements - PIEV Theory - Sight distances - Horizontal curves - Super elevation - Transition curves - Widening at curves - Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends - Lateral and vertical clearance at underpasses.

UNIT III DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 10

Flexible and Rigid Pavement - Components and functions - Design principles - Factors influencing design and performance of flexible and rigid pavement - Flexible pavement design - IRC recommended methods - Stresses in Rigid pavements - Rigid Pavement design - Design of Dowel bars and Tie bars.

UNIT IV HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE 9

Highway construction materials - Properties - Testing methods (Soil, Aggregate and Bitumen) - Construction practice of flexible and concrete pavements including modern materials and methods - Highway drainage - Highway Construction machineries.

UNIT V MAINTENANCE, EVALUATION AND STRENGTHENING OF PAVEMENTS 9

Types of maintenance - Maintenance management system and techniques - Defects in flexible and rigid pavements - Causes and Treatment - Pavement evaluation, roughness, present serviceability index, skid resistance, Structural evaluation by deflection measurements - Strengthening of pavements - Overlays - Stabilization techniques.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Describe the significance of highway planning, alignment and relate the principles of surveying to perform a route survey.

CO2 Apply the knowledge of engineering fundamentals in designing the geometric elements for an efficient highway network.

CO3 Design flexible and rigid pavements to meet specified needs of safety, efficiency and sustainability by adopting IRC design standards.

CO4 Demonstrate the quality tests of highway construction materials used in pavements.

CO5 Explain the construction practices of pavements and highway drainage system.

CO6 Evaluate the pavement for various distress and suggest appropriate strengthening techniques.

TEXT BOOKS:

1.Khanna K., Justo C.E.G, "Highway Engineering", Khanna Publishers, Roorkee, 2019.

2.Kadiyali L.R., "Principles and Practice of Highway Engineering", Khanna Technical Publications, New Delhi, 2019.

3.Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Sci Tech Publications (India), Chennai, 2018.

REFERENCES:

1.Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia, 2012.

2.Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, Ist Edition, USA, 2011.

3.Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi, 2011.

4.Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000.

5.IRC 37-2012, Guidelines for the Design of Flexible Pavements, The Indian Road Congress, New Delhi.

6.IRC 58-2012, Guideline for the Design of Rigid Pavements for Highways, The Indian Road Congress, New Delhi.

20CE411	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To expose the students to the testing of different materials under the action of various forces and to determine their characteristics experimentally.
- To introduce the usage of modern tools for validating the analytical results.
- To make them understand the professional and ethical responsibility in the areas of material testing.

LIST OF EXPERIMENTS

1.Determination of yield stress, ultimate stress and breaking stress of a mild steel rod by conducting tension test on universal testing machine.

2.Determination of compressive strength of concrete cube using compression testing machine.

3.Determination of ultimate shear stress of mild steel rod by conducting double shear test.

4.Determination of rigidity modulus by conducting torsion test on mild steel rod.

5.Determination of energy absorption capacity of mild steel specimen by conducting Izod Impact test.

6.Determination of energy absorption capacity of mild steel specimen by conducting Charpy Impact test.

7.Determination of Young's modulus of a metal beam with rectangular cross section by conducting deflection test.

8.Determination of Young's modulus of a wooden beam with rectangular cross section by conducting deflection test.

9.Determination of bending stress induced in metal/wooden beam for three different loadings by conducting deflection test.

10. Determination of rigidity modulus of an open coil spring by conducting deflection test.
11. Determination of rigidity modulus of a closed coil spring by conducting deflection test.
12. Draw shear force and bending moment diagrams of given beams with different loadings using open-source simulation tools.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Conduct deflection test on beams and springs.
CO2	Carryout tests on mild steel rod for shear, torsion and tension.
CO3	Perform compression tests on concrete.
CO4	Compute impact strength of rods by performing impact tests.
CO5	Identify hardness of metals by conducting hardness tests.
CO6	Draw shear force and bending moment diagrams of given loading using open-source simulation software.

REFERENCES

1.Singh. D.K., "Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016
2.Strength of Materials Laboratory Manual by Prof. K. Ramesh, Department of Applied Mechanics, IITM Chennai.
https://home.iitm.ac.in/kramesh/Strength%20of%20Materials%20Laboratory%20Manual.pdf
3. IS 1598:1977-Method for Izod impact test of metals
4. IS 1500: 2005, Method for Brinell Hardness Test for Metallic Materials, Fourth Revision, 2005.
5. IS 1586 (Part 1): 2012, Metallic materials — Rockwell hardness test: Part 1 Test method Fourth revision, 2012.

Open-Source Tool:

1. Free Online Beam Calculator for Cantilever or Simply Supported Beams. https://skyciv.com/free-beam-calculator/

Virtual Labs:

1. Virtual Labs and Technical Simulators, e-Learning Solutions for Education: https://virtlabs.tech/strength-materials/
2. NITK Surathkal: http://sm-nitk.vlabs.ac.in/

20CE412	**HYDRAULIC ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

- To make an understanding on the behavior of real fluid flows through hands on experience in calibration of flow meters.
- To provide hands on experience in measurement of major and minor losses in pipe flow.
- To impart knowledge on the performance characteristics of pumps and turbines.

LIST OF EXPERIMENTS

1.Calibration of Rotameter.
2.Determination of co-efficient of discharge for venturi meter.
3.Determination of co-efficient of discharge for orifice meter.

4.Determination of co-efficient of discharge for orifice.
5.Determination of co-efficient of discharge for notches.
6.Study of friction losses in pipes.
7.Study of minor losses in pipes.
8.Study on performance characteristics of Pelton turbine.
9.Study on performance characteristics of Francis turbine.
10.Study on performance characteristics of Kaplan turbine.
11.Study on performance characteristics of Centrifugal pump.
12.Study on performance characteristics of Gear pump.
13.Study on performance characteristics of Submersible pump.
14.Study on performance characteristics of Reciprocating pump.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Measure flow in pipes.

CO2 Compute major and minor losses in pipe flow.

CO3 Determine the performance characteristics of rotodynamic pumps.

CO4 Determine the performance characteristics of positive displacement pumps.

CO5 Evaluate the performance characteristics of various turbines.

CO6 Work in groups and as an individual and document results.

REFERENCES:

1. Modi P.N. and Seth. S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2019.
2. Subramanya K, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Edu. Pvt. Ltd. 2018.

Virtual Lab:

NITK Surathkal: http://fm-nitk.vlabs.ac.in/#

		L	T	P	C
20CS414	**APTITUDE AND CODING SKILLS – II (Common to All Branches)**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

1. English – Phase II

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase II

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number

series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase II

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase II

Logical, Compilation and Code reuse

5. Automata - Phase II

Data Structure Concepts: Array and Matrices, linked list, String processing and manipulation, Stack/Queue, Sorting and Searching

Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Develop advanced vocabulary for effective communication and reading skills.
CO2	Build an enhanced level of logical reasoning and quantitative skills.
CO3	Develop error correction and debugging skills in programming.
CO4	Apply data structures and algorithms in problem solving.

SEMESTER - V

		L	T	P	C
20CE501	**BASIC REINFORCED CONCRETE DESIGN**	**3**	**2**	**0**	**4**

OBJECTIVES:

- To introduce various design philosophies and apply them in designing various structural elements.
- To impart conceptual knowledge on the design of beams, slabs, columns and footing as per Indian standards
- To append the design with detailing for good construction practices.

UNIT I INTRODUCTION AND DESIGN OF BEAMS 15

Design Methods – concept of working stress method, ultimate load method and limit state method – Limit state philosophy as detailed in IS code - basic assumptions- design of singly and doubly reinforced rectangular beams- design of flanged beam- minimum and maximum reinforcement requirement. Design of Sections in shear, bond and torsion, diagonal tension, shear reinforcement, development length, equivalent shear, Torsional reinforcement.

UNIT II DESIGN OF SLABS AND STAIRCASE 12

Design of Slabs using limit state method - one way and two-way slabs for different edge conditions- Stair cases - different types- design of dog legged staircase- waist slab type- riser-tread type. Reinforcement detailing of staircases.

UNIT III DESIGN OF COMPRESSION MEMBERS 12

Design of columns using limit state method - axially loaded– square, rectangular and circular cross sections with lateral and spiral ties – design of short columns for uniaxial and biaxial eccentricities using interaction charts – reinforcement detailing.

UNIT IV DESIGN OF FOOTING 12

Limit state design of shallow foundation – Isolated footing – square and rectangular – combined footing – rectangular and trapezoidal – reinforcement detailing.

UNIT V RENFORCEMENT DETAILING PRACTICES 9

Detailing requirements as per SP 34- development length of bars in tension or compression – anchoring of reinforcing bars – curtailment of reinforcement - splicing of reinforcement – lap splice – couplers – dowels and bar support – beam-column joint in a structure – detailing of expansion and contraction joint.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Explain various design philosophies for the design of RC elements
CO2	Apply limit state concepts to design rectangular and flanged beams
CO3	Design different types of slabs and staircase using limit state method.
CO4	Design of columns subjected to various loading condition using limit state method.
CO5	Design isolated footing and combined footing using limit state method.
CO6	Appraise good detailing practices followed and sketch its details.

TEXTBOOKS:

1. M.L. Gambhir, "Fundamentals of Reinforced Concrete Design', Prentice Hall of India Private Limited, New Delhi, 2009.
2. N. Krishna Raju and R.N. Pranesh, Reinforced Concrete Design IS 456-2000, Principles and practice, New Age International (P) Ltd Publishers, New Delhi, 2018.

3. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (4th Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2021.
4. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.

REFERENCES:

1. B.C. Punmia. Ashok K. Jain and Arun K. Jain, RCC Designs (Reinforced Concrete Structures), Lakshmi Publications (P) Ltd., New Delhi, 9th Edition, 2015.
2. P.C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd., New Delhi, 2004.
3. Self-learning materials – Online courses - http://www.nptel.iitm.ac.in/
4. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
5. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
6. SP 34:1987 Handbook of concrete reinforcement and detailing.

		L	T	P	C
20CE502	**STRUCTURAL ANALYSIS**	**3**	**2**	**0**	**4**

OBJECTIVES:

- To impart knowledge on the basic theory and concepts of structural analysis.
- To provide understanding on the calculation of internal forces and moments of indeterminate beams.
- To instill knowledge on analysis of indeterminate plane frames and pin joined frames.

UNIT I STRAIN ENERGY METHOD 12

Determination of Static and Kinematic Indeterminacies – Analysis of continuous beams, indeterminate frames and trusses by strain energy method (up to two degree of redundancy).

UNIT II SLOPE DEFLECTION METHOD 12

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frame - Support settlements- symmetric and unsymmetrical frames with symmetric and skew-symmetric loadings.

UNIT III MOMENT DISTRIBUTION METHOD 12

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

UNIT IV FLEXIBLITY MATRIX METHOD 12

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

UNIT V STIFFNESS MATRIX METHOD 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the concept of indeterminate structures and analyse the structure using various methods.
CO2	Analyse continuous beams, pin-jointed indeterminate plane frames and rigid plane frames using strain energy method

CO3	Analyse continuous beams and rigid frames using slope defection method
CO4	Analyse continuous beams and rigid frames with and without sway using moment distribution method.
CO5	Analyse indeterminate pin jointed plane frames, continuous beams and rigid frames using matrix flexibility method.
CO6	Analyse indeterminate pin jointed plane frames, continuous beams and rigid frames using matrix stiffness method.

TEXTBOOKS:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol.2", Laxmi Publications, New Delhi, 2014.
2. Bhavikatti, S.S, "Matrix Method of Structural Analysis", I. K. International Publishing House Pvt. Ltd., New Delhi-4, 2014.

REFERENCES:

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", Laxmi Publications, New Delhi, 2017.
2. Bhavikatti, S.S, "Structural Analysis", Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi-4, 2014.
3. Gambhir, M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.

20CE503	**ENVIRONMENTAL ENGINEERING I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the sources of water and its demand.
- To impart knowledge on water treatment processes and its design aspects
- To provide adequate information on distribution system and different plumbing systems.

UNIT I PLANNING FOR WATER SUPPLY SYSTEM 9

Public water supply system -Planning -Objectives -Design period -Population forecasting -Water demand -Sources of water and their characteristics -Surface and Groundwater- Impounding Reservoir Well hydraulics -Development and selection of source - Water quality - Characterization -Water quality standards.

UNIT II COLLECTION AND CONVEYANCE OF WATER 9

Water supply -intake structures -Functions and drawings -Pipes and conduits for water- Pipe materials -Hydraulics of flow in pipes -Transmission main design -Laying, jointing and testing of pipes - Drawing appurtenances - Types and capacity of pumps -Selection of pumps and pipe materials.

UNIT III PRIMARY TREATMENT 9

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

UNIT IV ADVANCED WATER TREATMENT 9

Aerator- Iron and manganese removal, Deflouridation and demineralization -Water softening - Desalination -Membrane Systems -Construction and Operation & Maintenance aspects of Water Treatment Plants -Recent advances -Membrane Processes.

UNIT V WATER DISTRIBUTION AND SUPPLY TO BUILDINGS 9

Requirements of water distribution -Components -Service reservoirs -Functions and drawings - Network design -Economics -Computer applications -Analysis of distribution networks - Appurtenances -operation and maintenance -Leak detection, Methods - Principles of design of water supply in buildings -House service connection -Fixtures and fittings -Systems of plumbing and drawings of types of plumbing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the water supply system, water sources and water quality characteristics and standards.
CO2	Determine the demand of water for the current and forecasted population.
CO3	Explain the collection and conveyance of water.
CO4	Design, operate and maintain water treatment plants.
CO5	Describe advanced water treatment processes to improve the water quality.
CO6	Design the water distribution system, connection, fixtures and fittings.

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol. I Khanna Publishers, New Delhi, 2010
2. Punmia, B.C., Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2019.

REFERENCES:

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2009.
2. Syed R. Qasim and Edward M. Motley Guang Zhu, "Water Works Engineering Planning, Design and Operation", Prentice Hall of India Learning Private Limited, New Delhi, 2009
3. Peary, H.S., ROWE, D.R., Tchobanoglous, G., "Environmental Engineering", McGraw- Hill Book Co., New Delhi, 2017.
4. Modi, P.N., "Water Supply Engineering", Vol.I, Standard Book House, New Delhi, 2010.
5. Birdie, G.S, and Birdie. J. S, "Water Supply and Sanitary Engineering", Dhanpat Rai & Sons, 2012.

20CE504 FOUNDATION ENGINEERING

L	T	P	C
2	2	0	3

OBJECTIVES:

- To emphasize the importance of soil exploration and suggest a suitable type of sub surface investigation technique for a particular site and structure.
- To give exposure on the geotechnical design aspects of shallow and deep foundations
- To create understanding on the importance of assessment of earth pressure in checking the stability of retaining walls

UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9

Soil exploration - Scope and objectives – Planning – Reconnaissance - Methods of subsurface exploration – Test pits - Auger and wash borings – Percussion and rotary drilling– Depth of exploration- Spacing and number of bore holes – Sampling in soils and rocks – Types of samplers– Static and Dynamic Penetration tests– Geophysical explorations - Preparation of bore logs and subsurface exploration report - Selection of foundations based on soil conditions.

UNIT II SHALLOW FOUNDATION 9

Functions of foundations – Requirements of good foundation – Bearing capacity - Basic Definitions and factors affecting bearing capacity – Types of shear failures - Analytical methods-

Terzaghi, BIS and Skempton's formulae - Bearing capacity from field tests (SPT, CPT and Plate load tests)- Allowable bearing pressure – Methods of improvement of soil bearing capacity - Causes of settlement – Estimation of immediate and consolidation settlement– Total and differential settlement – Allowable settlements – Codal requirements – Methods of minimizing total and differential settlements.

UNIT III FOOTINGS AND RAFTS 9

Types of shallow foundations – Geotechnical design of combined and strap footings – Method of proportioning - Types of raft foundations - Conventional design procedure for rigid raft foundation – Fully and partially compensated foundations - Contact pressure and settlement distribution under rigid and flexible footing –Seismic force consideration – Codal provisions.

UNIT IV PILE FOUNDATION 9

Classification of piles and their functions – Factors influencing the selection of pile – Load carrying capacity of pile in granular and cohesive soil – Static and Dynamic formulae – Determination of bearing capacity from penetration tests - Interpretation of continuous pile load test– Analysis of pile groups –Static and empirical formulae - Group efficiency - Feld's rule – Converse Labarre formula - Group action and pile spacing - Negative skin friction – Settlement of pile groups –Under reamed piles – Capacity under compression and uplift – Codal provisions.

UNIT V RETAINING WALLS 9

Lateral Earth Pressure – Plastic equilibrium - Different types of earth pressures- Rankine's theory - Active and passive earth pressure for cohesionless and cohesive soils - Earth pressure at rest - Coloumb's wedge theory - Rebhann's and Culmann's graphical solutions, Stability analysis of retaining walls - Codal provisions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the importance of soil exploration for any civil engineering construction
CO2	Estimate bearing capacity of soils and the probable settlement of foundations
CO3	Decide proportioning of shallow foundation under different soil conditions and also get exposed in foundation analysis
CO4	Design raft and floating foundations under weak compressible soils.
CO5	Determine load carrying capacity and settlement of pile foundation under various soil conditions
CO6	Calculate earth pressure for granular and cohesive soils and carryout stability analysis on retaining walls.

TEXTBOOKS:

1. Gopal Ranjan and A.S.R. Rao, A.S.R "Basic and Applied Soil Mechanics" Wiley Eastern Ltd., New Delhi, 3rd Edition, 2016.
2. Venkatramaiah C., "Geotechnical Engineering ", New Age International Publishers, 6th Edition, 2018.

REFERENCES:

1. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
3. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014
4. Joseph E. & Bowles, Foundation Analysis & Design,5th Edition, McGraw Hill Pub., 2001

20CE505	RAILWAYS, AIRPORTS, DOCKS AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an understanding on components and geometrical elements in railway construction.
- To familiarize the design standards of runway, taxiway and air transport characteristics.
- To impart knowledge on different types of coastal structures.

UNIT I RAILWAY PLANNING AND CONSTRUCTION 10

Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings.

UNIT II RAILWAY CONSTRUCTION AND MAINTENANCE 8

Earthwork – Stabilization of track on poor soil – Track Drainage – Calculation of Materials required for track laying - Construction and maintenance of tracks – Railway Station and yards and passenger amenities- Signaling.

UNIT III AIRPORT PLANNING 7

Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area.

UNIT IV AIRPORT DESIGN 10

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.

UNIT V HARBOUR ENGINEERING 10

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works – Coastal Regulation Zone.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Describe the concepts and elements in planning, design and construction of railways.
CO2	Apply appropriate methods for construction and maintenance of railway tracks and other infrastructure.
CO3	Identify the concepts and elements in planning and selection of site for airport.
CO4	Analyze and design the runway length and evaluate the orientation of runways.
CO5	Explain the terminologies and infrastructures in harbour engineering.
CO6	Understand types of coastal protection structures and coastal regulations.

TEXTBOOKS:

1. Saxena Subhash. C.and Satyapal Arora, “A Text Book of Railway Engineering”, Dhanapat Rai and Sons, Delhi, 2013
2. Rangwala, "Airport Engineering", Charotar Publishing House, 17th Edition 2019
3. Bindra S P, "A Course in Docks and Harbour Engineering", Dhanpat Rai and Sons, New Delhi, 2012

REFERENCES:

1. Venkatramaiah. C., "Transportation Engineering-Vol.2: Railways, Airports, Docks and Harbours, Bridges and Tunnels", Universities Press (India) Private Limited, Hyderabad, 2016.
2. Mundrey J S, "Railway Track Engineering", McGraw Hill Education (India) Private Ltd, New Delhi, 2017

20CE511	GEOTECHNICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To demonstrate testing equipment to determine physical index and compaction characteristics of different types of soils.
- To determine engineering properties of different types of soils.
- To classify different types of soil based on grain size distribution

LIST OF EXPERIMENTS

1. Determination of specific gravity of coarse and fine-grained soils
2. Grain size distribution – Sieve analysis
3. Grain size distribution – Hydrometer analysis
4. Determination of consistency limits of fine-grained soils
5. Differential free swell tests.
6. Determination of field density (a) Sand replacement method (b) Core cutter method
7. Determination of moisture content – dry density relationship using standard proctor compaction test.
8. Determination of relative density of granular soils
9. Determination of coefficient of permeability by (a) Constant head method, (b) Variable head method.
10. Determination of co-efficient of consolidation using one dimensional consolidation test.
11. Determination of shear strength parameters of cohesionless soil by conducting Direct shear test
12. Determination of shear strength parameters of cohesive soil by conducting Unconfined compression test
13. Determination of shear strength parameters of cohesive soil by conducting Laboratory vane shear test
14. Tri-axial compression test in cohesionless soil (Demonstration only)
15. California Bearing Ratio Test

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Determine the index properties of coarse and fine-grained soils
CO2	Perform compaction tests on coarse and fine-grained soils.
CO3	Carryout permeability tests on granular and cohesive soils for the determination of coefficient of permeability
CO4	Determine the compressibility characteristics of fine-grained soils by conducting one dimensional consolidation tests.
CO5	Compute shear strength of soils by performing direct shear test, triaxial shear test, vane shear test & unconfined compressive tests.
CO6	Classify the type of soil and ascertain the suitability for different types of construction.

REFERENCES
1. Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008.
2. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
3. William A. Kitch, "Geotechnical Engineering Lab Manual" 2011.
4. IS Code of Practice (2720), Bureau of Indian Standards, New Delhi.
5. Braja M.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, 8th Edition, 2012.

Virtual Labs:
1. http://www.vlab.co.in/broad-areacivil-engineering / smfe-iiith.vlabs.ac.in/

20CE512	CONCRETE AND HIGHWAY ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:
- To familiarize the physical and strength characteristics of coarse aggregates as per code of practices.
- To introduce several tests on fresh and hardened properties of concrete.
- To give exposure on various properties of bitumen and bituminous mixes.

LIST OF EXPERIMENTS

I. TESTS ON AGGREGATES
1. Grading of Aggregates
2. Specific Gravity and Water Absorption
3. Flakiness and Elongation Index
4. Crushing Value
5. Impact Value
6. Los Angeles Abrasion Value

II. TESTS ON FRESH CONCRETE
1. Slump Cone
2. Flow Table
3. Compaction Factor

III. TESTS ON HARDENED CONCRETE
1. Compressive Strength
2. Split Tensile Strength
3. Flexural Strength

IV. TESTS ON BITUMEN
1. Penetration
2. Ductility
3. Viscosity

V. TESTS ON BITUMINOUS MIXES
1. Determination of Binder Content
2. Marshall Stability and Flow values

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:

CO1 Analyze the physical properties of coarse aggregates as per code of practices.
CO2 Examine the strength characteristics of coarse aggregates.

CO3 Determine the various properties of fresh concrete.
CO4 Evaluate the hardened value of concrete cubes, cylinders and prism.
CO5 Assess the different properties of fresh bitumen.
CO6 Determine the hardened properties of bitumen mixes.

REFERENCES:

1. Shetty.M.S, A.K.Jain, "Concrete Technology - Theory and Practice", S.Chand and Company Ltd, New Delhi, 8th Edition, 2019.
2. Neville. A.M, "Properties of Concrete", Pitman Publishing Limited, London, 5th Edition, 2012.
3. IS 2386 (Part 1 to Part 6) – 1963: Methods of Test for Aggregates for Concrete (Reaffirmed Year: 2021)
4. IS 516 (1959): Method of Tests for Strength of Concrete, (Reaffirmed Year: 2018)
5. IS 1201 to 1220 (1978): Methods for Testing Tar and Bituminous Materials,(Reaffirmed Year: 2019)

Virtual Labs:

1. NITK Surathkal: https://ts-nitk.vlabs.ac.in/transportation-engineering/
2. IIT Delhi: https://cs-iitd.vlabs.ac.in/

20CS512	ADVANCED APTITUDE AND CODING SKILLS - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

LIST OF EXERCISES:

1. English – Phase I Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I Advanced

Logical, Compilation and Code reuse

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Develop vocabulary for effective communication and reading skills.

CO2 Build the logical reasoning and quantitative skills.

CO3 Develop error correction and debugging skills in programming.

		L	T	P	C
20CE513	**INTERNSHIP**	**0**	**0**	**0**	**1**

OBJECTIVES:

- To enhance knowledge in professional engineering practices through industrial training on the latest technological developments.
- To create practical awareness on problem solving skills for real time applications.
- To impart practical knowledge by involving in industrial projects.

STRATEGY:

The students individually undertake training in reputed civil engineering companies for a maximum period of four weeks. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated based on the presentation during the viva voce examination.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Bridge the gap between Industrial requirements and academic learning.
CO2	Apply acquired knowledge to real-time applications.
CO3	Carryout multi-disciplinary projects under the guidance of industry and academic supervision.
CO4	Extend the knowledge through research and development in specialized areas.
CO5	Understand the intricacies involved in solving complex engineering problems.
CO6	Exposed to industrial culture and team work.

EVALUATION PROCEDURE:

The method of evaluation will be as follows:

1. Project report : **40 marks**
2. Presentation : **40 marks**
3. Viva-voce : **20 marks**

SEMESTER - VI

		L	T	P	C
20CE601	**ADVANCED REINFORCED CONCRETE DESIGN**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To impart knowledge in designing retaining walls and water tanks.
- To familiarize with the design of various structural systems like flat slab, Deep beam and grid floor.
- To give exposure on the characteristics of yield line and determine collapse load for various slabs.

UNIT I RETAINING WALLS **9**

Types of retaining wall –Forces acting on retaining wall- Stability requirement - Design of Cantilever and Counterfort Retaining walls using limit state method.

UNIT II WATER TANKS **9**

Limit state design of water tank- Tank resting on ground - Underground water tanks - Elevated circular water tank – Reinforcement detailing

UNIT III YIELD LINE THEORY **9**

Assumptions - Characteristics of yield line - Determination of collapse load / plastic moment - Application of virtual work method - Square, rectangular, circular and triangular slabs - Design problems

UNIT IV FLAT SLABS AND GRID BEAMS **9**

Components of flat slab – design of flat slab with column head - design of flat slab with drop and column head – check for shear stresses – Introduction and design of grid floors by IS Code method.

UNIT V DEEP BEAMS, DEFLECTION AND CRACK WIDTH **9**

Behaviour of deep beams, bending stresses and shear stresses, design of deep beams using limit state method - Short-term and long-term deflection of beams, calculation of deflection using IS code - Factor affecting crack width, calculation of crack width in beams.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Design cantilever and counterfort retaining walls.
CO2 Design various types of water tanks.
CO3 Interpret the characteristics of yield line for slabs of various geometric shapes.
CO4 Design interior and exterior panel of flat slab.
CO5 Outline the behavior of deep beams and design them.
CO6 Predict the deflection and crack width criteria of beams.

TEXTBOOKS:

1. P. C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd. New Delhi, 2013
2. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014
3. N. Krishna Raju, Advanced Reinforced Concrete Design IS 456-2000 (Third Edition), CBS Publishers and Distributors, New Delhi, 2016.

REFERENCES:

1. B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, RCC Designs (Reinforced Concrete Structures), Laxmi Publications Pvt. Ltd., New Delhi, 2015.
2. I.C.Syal and A.K.Goel, "Reinforced Concrete Structures", S. Chand and Company Ltd, New Delhi, 2012.
3. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
4. IS 3370: 2009 Concrete structures for storage of liquids- Code of practice.

20CE602	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To introduce the concept of influence lines and its applications in beams and plane trusses.
- To impart knowledge on the analysis of arches, cables and suspension bridges.
- To provide understanding on the advanced methods of analysis.

UNIT I INFLUENCE LINES FOR DETERMINATE AND INDETERMINATE BEAMS AND FRAMES **9**

Influence lines for reactions in statically determinate beams – Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads – absolute maximum bending moment - influence lines for member forces in pin jointed plane frames. Muller Breslau's principle– Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one), and fixed beams.

UNIT II ARCHES **9**

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

UNIT III CABLES AND SUSPENSION BRIDGES **9**

Equilibrium of cable – length of cable - anchorage of suspension cables – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders.

UNIT IV PLASTIC ANALYSIS **9**

Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – collapse load - Static and kinematic methods – Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

UNIT V FINITE ELEMENT METHOD **9**

Introduction –basic steps involved in FEM - various coordinates in FEM - Displacement functions – shape functions – 2D Beam element – triangular element (max 3 nodes) – strain displacement matrix and strains for triangular element.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Calculate critical stress resultants for statically determinate structures using influence line diagram.
CO2	Understand Muller Breslau principle and draw the influence lines for statically indeterminate beams.

CO3 Analyse three hinged, two hinged and fixed arches.
CO4 Analyse suspension bridges with stiffening girders.
CO5 Analyse beams and rigid frames using the concept of plastic analysis.
CO6 Understand the concept of finite element analysis.

TEXTBOOKS:

1. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis" – Vol. 1 & Vol. 2, Laxmi Publications, New Delhi, 2014.
2. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", Laxmi Publications, New Delhi, 2017.
3. Bhavikatti, S.S, "Structural Analysis", Vol.1 & 2, Vikas Publishing House Pvt. Ltd., New Delhi - 4, 2014.

REFERENCES:

1. Gambhir, M.L., "Fundamentals of Structural Mechanics and Analysis", PHI Learning Pvt. Ltd., New Delhi, 2011.
2. Negi. L. S, Jangid R S, "Structural Analysis" Tata Mc. Graw Hill Publication, New Delhi, 2004
3. David Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Education, 2017.
4. Krishnamoorthy C S, "Finite Element Analysis: Theory and Programming" 2nd Edition, Tata Mc. Graw Hill Publication., New Delhi, 2017

		L	T	P	C
20CE603	**ENVIRONMENTAL ENGINEERING II**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide understanding on different characteristics of sewage.
- To introduce physical, chemical and biological processes in waste water treatment.
- To impart knowledge on advanced water treatment processes and disposal methods.

UNIT I PLANNING FOR SEWERAGE SYSTEMS 9

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

UNIT II SEWER DESIGN 9

Sewerage – Hydraulics of flow in sewers – Objectives – Design period - Design of sanitary and storm sewers – Small bore systems - Computer applications – Laying, joining & testing of sewers – appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.

UNIT III PRIMARY TREATMENT OF SEWAGE 9

Objective – Unit Operation and Processes – Selection of treatment processes – Onsite sanitation - Septic tank, grey water harvesting – Primary treatment – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects.

UNIT IV SECONDARY TREATMENT OF SEWAGE 9

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.

UNIT V DISPOSAL OF SEWAGE AND SLUDGE 9

Standards for Disposal - Methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sewage farming – Deep well injection – Soil dispersion system -

Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in sludge treatment and disposal.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Understand the characteristics and composition of sewage for the estimation of sewage generation.
- **CO2** Explain the concept of sewer design and testing methodologies.
- **CO3** Design the unit operations in sewage treatment system.
- **CO4** Appraise self-purification of streams and sludge disposal methods.
- **CO5** Summarize advanced waste water treatment processes.
- **CO6** Apply various sewage and sludge disposal methods for industrial applications.

TEXTBOOKS:

1. Garg, S.K. Environmental Engineering, Vol.II Khanna Publishers, New Delhi, 2021.
2. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2016.

REFERENCES:

1. "Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development", Government of India, New Delhi, 2013.
2. Metcalf and Eddy "Wastewater Engineering–Treatment and Reuse", Tata McGraw-Hill Company, New Delhi, 2017.
3. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C.,2017.
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.
5. Karia G L & Christian R A, "Wastewater Treatment", Prentice Hall of India, New Delhi, 2013.

		L	T	P	C
20CE604	**DESIGN OF STEEL STRUCTURES**	**3**	**2**	**0**	**4**

OBJECTIVES:

- To impart conceptual knowledge on the limit state of design of steel connections using bolted and welded connections.
- To give exposure to the design of tension, compression and flexural members.
- To introduce the design of plate girders and roof trusses.

UNIT I INTRODUCTION TO LIMIT STATE METHOD 12

Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Bolted connections– Modes of failure-the concept of Shear lag-efficiency of joints- Axially loaded bolted connections for Plates and Angle Members using bearing type bolts. Eccentrically Loaded Bolted Bracket Connections- Welds-symbols and specifications- Effective area of welds-Fillet and but Welded connections -Axially Loaded connections for Plate and angle truss members and Eccentrically Loaded bracket connections.

UNIT II TENSION MEMBERS 9

Tension Members - Types of Tension members and sections –Behaviour of Tension Members-modes of failure-Slenderness ratio- Net area – Net effective sections for plates, angle and T section in tension –Concept of Shear Lag- Design of plate and angle tension members-design of built-up tension Members - Connections in tension members – Design of lug angles.

UNIT III COMPRESSION MEMBERS 15

Types of compression members and sections–Behaviour and types of failures - short and slender

columns- Codal provisions for compression members - Effective length, Slenderness ratio – Column formula and column curves- Design of single section and compound angles-Axially loaded solid section columns- Design of built up Laced and Battened type columns – Design of column bases – Plate and Gusseted bases for Axially loaded columns.

UNIT IV FLEXURAL MEMBERS 12

Types of steel beam sections- Behaviour of beams in flexure- Codal Provisions – Classification of cross sections- Flexural Strength and Lateral stability of Beams –Shear Strength-Web Buckling, Crippling and deflection of Beams- Design of laterally supported Beams- Design of solid rolled section beams- Design of plated beams with cover plates - Design strength of laterally unsupported beams – Design of laterally unsupported rolled section beams- Purlin in roof trusses-Design of Channel and I section Purlins.

UNIT V PLATE GIRDERS AND ROOF TRUSSES 12

Elements of plate girder, proportioning of web and flanges, flexural strength, shear strength of web, design of stiffeners – Flange and web splices – Wind load on roof trusses.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the properties of steel sections and the concept of limit state method of design.
CO2	Design bolted and welded connections for steel structures.
CO3	Design tension members with the knowledge of shear lag effect.
CO4	Design axially loaded columns, built up columns and column bases.
CO5	Appraise the behavior of beams and design laterally restrained and un-restrained beams.
CO6	Design plate girders and truss members.

TEXTBOOKS:

1. Duggal. S.K, "Limit State Design of Steel Structures", 3rd Edition. Tata McGraw Hill Publishing Company, 2019.
2. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2018.
3. Bhavikatti.S.S, "Design of Steel Structures" By Limit State Method as per IS:800–2007, IK International Publishing House Pvt. Ltd., 2013.

REFERENCES:

1. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013.
2. Shiyekar. M.R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
3. P. Dayarathnam, Design of steel structures, S Chand & Co Ltd, New Delhi, 2012
4. IS800 :2007, General Construction in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007.

		L	T	P	C
20CE611	**ENVIRONMENTAL ENGINEERING LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To introduce the testing of water for various characteristics.
- To study the growth of micro-organism and its quantification.
- To create understanding on physical, chemical and biological characteristics of water and wastewater.

LIST OF EXPERIMENTS

1. Determination of pH, Turbidity and conductivity
2. Determination of Hardness
3. Determination of Alkalinity and Acidity
4. Determination of Chlorides
5. Determination of Sulphates
6. Determination of iron and fluoride
7. Determination of Optimum Coagulant dosage
8. Determination of residual chlorine and available chlorine in bleaching powder
9. Determination of suspended, settleable, volatile and fixed solids
10. Determination of Dissolved Oxygen for the given sample
11. Determination of BOD for the given sample
12. Determination of COD for the given sample
13. Study of SVI of Biological sludge and microscopic examination
14. Study of MPN index of given water sample

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Quantify the pollutant concentration in water and wastewater.

CO2 Suggest the type of treatment required and amount of dosage required for the treatment.

CO3 Examine the conditions for the growth of micro-organisms.

CO4 Analyze the physical, chemical and biological characteristics of water and wastewater.

CO5 Quantify the sludge in the waste water treatment.

CO6 Ensure the quality of water according to Indian standards.

REFERENCES:

1. Punmia B C. Ashok kumar Jain, Arun Kumar Jain, "Water supply Engineering", Laxmi Publications, 2019.
2. Punmia B C. Ashok kumar Jain, Arun Kumar Jain, "Wastewater Engineering", Laxmi Publications, 2019.
3. https://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf
4. https://bis.gov.in/wp-content/uploads/2020/10/PM-IS-10500.pdf

rtual Labs:

1. https://ee1-nitk.vlabs.ac.in/
2. https://ee2-nitk.vlabs.ac.in/

		L	T	P	C
20CE612	**BUILDING INFORMATION MODELING LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To impart knowledge on building information modeling using Revit.
- To provide knowledge on detailing of RC and steel structure.
- To create understanding on clash detection and to develop clash free model using Navisworks

Topics on BIM:

1. Introduction to BIM

Introduction to BIM – BIM vs Revit – Modeling Basics – Adding Levels and Grids – Design of Architectural Components – Adding Walls, Roof and Ceiling – Joining/Unjoining of Roof – Adding Doors and Windows – Curtain wall, curtain grids and Mullions

2. Structural Modeling and Connections

Creating Structural element- Footing, Column, Beam, Slab and Steel truss– Working with Floor and Creating a Floor Opening – Creating Stairs, Ramps, lifts, Railings – Loading and Placing component – Model in place – Modeling Connections.

3. Drafting Views and Annotations

Creating Plan Views- Creating Elevation and Section Views- Creating 3D Views- Modifying Views - Creating Details – Adding Tags and Schedules – Introduction to Work sets – Creating New Families - Modifying Family Definition - Exterior Renderings.

4. Introduction to Navisworks

Introduction to Navisworks – Overview of Interface – Append and Align Models – Use of Selection Tree – Properties investigation – Finding Items and Search Sets.

5. Clash Detection

Review Federated model – Markup of Model – Measuring Tools – Overview of Scheduling – Overview of Clash Detection.

LIST OF EXERCISES:

1. Plot the plan and elevation for a given specification.
2. Create an architectural 3D model for the given plan and elevation.
3. Positioning of column, beam, slab and foundation for the given model.
4. Create a 3D model for the given steel structure.
5. Prepare structural detail drawing and bill of quantities for the given RC structure.
6. Prepare structural detail drawing and bill of quantities for the given steel structure.
7. Create a federated model to analyze clashes and deliver a clash-free model.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Develop a 3D model using Building Information Modelling.
CO2	Position the structural elements in the 3D BIM model.
CO3	Create a 3D model to furnish the structural details of RC members
CO4	Develop a 3D model for connection detailing of steel members.
CO5	Create a federated model to analyze clashes and to deliver a clash-free model.
CO6	Develop architectural and structural models based on project standards and respective documents for construction stage.

REFERENCES

1. Eastman, C., Teicholz, P., Sacks, R., & Liston, C. BIM handbook: "A guide to building information modeling for owners, managers, designers, engineers and contractors", John Wiley& Sons, 2011.
2. Hardin, B., & McCool, D., "BIM and construction management: proven tools, methods, and workflows", John Wiley & Sons, 2015.
3. Issa, R. R., & OlbinaS., "Building Information Modeling Applications and Practices", American Society of Civil Engineers, 2015.
4. Pittard, S., & Sell, P. "BIM and Quantity Surveying" Routledge, 2016.
5. https://academy.autodesk.com/curriculum/introduction-bim

20CS614	ADVANCED APTITUDE AND CODING SKILLS - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

1.English – Phase II Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase II Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase II Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase II Advanced

Logical, Compilation and Code reuse

5. Automata - Phase II Advanced

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Develop advanced vocabulary for effective communication and reading skills.
CO2 Build an enhanced level of logical reasoning and quantitative skills.
CO3 Develop error correction and debugging skills in programming.
CO4 Apply data structures and algorithms in problem solving.

SEMESTER VII

		L	T	P	C
20CE701	**ESTIMATION, COSTING AND VALUATION ENGINEERING**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To impart knowledge on quantity estimation of buildings and special structures.
- To provide knowledge on rate analysis, cost estimation of various items of work and value of property.
- To develop skills on technical report writing, preparation of tender and contract document.

UNIT I QUANTITY ESTIMATION 9

Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, roads, septic tank, soak pit, retaining walls – culverts.

UNIT II RATE ANALYSIS AND COSTING 9

Standard Data – Observed Data – Schedule of rates – Market rates – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads– Cost Estimates - Analysis of rates for the item of work, labour, cost of material and labour for a specified schedule of rate.

UNIT III SPECIFICATIONS, REPORTS AND TENDERS 9

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

UNIT IV CONTRACTS 9

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

UNIT V VALUATION 9

Definitions – Various types of valuations – Valuation methods - Necessity – Capitalised value – Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent – Mortgage – Lease.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Estimate the quantities for buildings, roads, septic tank, soak pit, retaining walls and culverts.
CO2	Outline the standard data and schedule of rates for labour and materials
CO3	Analyse the rate and cost estimate for buildings, canals, and roads as per the schedule of rates.
CO4	Prepare technical report, tender and contract documents for various work with detailed specifications.
CO5	Understand bidding and types of contracts, arbitration and legal requirements.
CO6	Perform valuation of property and calculate rent, mortgage and lease of land and buildings.

TEXTBOOKS:

1. Dutta B N, "Estimating and Costing in Civil Engineering", 27th Edition, UBS Publishers & Distributors Pvt. Ltd, Noida, 2016
2. Rangwala C, "Estimating, Costing and Valuation", 17th Edition, Charotar Publishing House Pvt. Ltd, Gujarat, 2017

REFERENCES:

1. Vazirani V N, Chandola S P, "Estimating and costing", 6th Edition, Khanna Publishers, Delhi, 2015.
2. Chakraborti M, "Estimating Costing Specification and Valuation in Civil Engineering", 24th Edition, Jain Book, India, 2012.
3. BirdieG.S, "A Text Book on Estimating and Costing", Dhanpat Rai Co. Pvt. Ltd., New Delhi, 2014.
4. Standard schedule of rates and standard data book by Public Works Department Tamil Nadu Transparencies in Tenders Act, 2000.

20CE702	WATER RESOURCES AND IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give exposure on water resources planning and management.
- To familiarize the concepts of National Water Policy and master plan.
- To introduce the concept of irrigation engineering, methods and management.

UNIT I WATER RESOURCES 9

Water resources survey – Water resources of India and Tamilnadu – Description of water resources planning – Estimation of water requirements for irrigation and drinking- Single and multipurpose reservoir – Multi objective - Fixation of Storage capacity -Strategies for reservoir operation - Design flood-levees and flood walls.

UNIT II WATER RESOURCE MANAGEMENT 9

Economics of water resources planning; – National Water Policy – Consumptive and non-consumptive water use - Water quality – Scope and aims of master plan - Concept of basin as a unit for development - Water budget- Conjunctive use of surface and ground water.

UNIT III IRRIGATION ENGINEERING 9

Need – Merits and Demerits – Duty, Delta and Base period – Irrigation efficiencies – Crops and Seasons - Crop water Requirement – Estimation of Consumptive use of water.

UNIT IV CANAL IRRIGATION 9

Types of Impounding structures: Gravity dam – Diversion Head works - Canal drop – Cross drainage works – Canal regulations – Canal outlets – Canal lining - Kennady's and Lacey's Regime theory.

UNIT V IRRIGATION METHODS AND MANAGEMENT 9

Lift irrigation – Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation - Merits and demerits – Irrigation scheduling –Water User Association (WUA) - Participatory irrigation management with a case study – Water Pricing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Describe the significance of water resource and the strategies in reservoir operation.

CO2 Explain the concepts of national water policy and water resources management.
CO3 Analyze the crop water requirements and consumptive use of water.
CO4 Design the components of impounding structures and diversion head works, canal drops and cross drainage works.
CO5 Discuss the concepts of Kennady's and Lacey's regime theory in irrigation.
CO6 Explain the aspects of water user association and participatory irrigation management.

TEXTBOOKS:
1. Punmia B.C., Pandha.B.B; "Irrigation and water power Engineering", Laxmi Publications, 17th Edition, New Delhi, 2021.
2. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 36th Edition, New Delhi, 2019.

REFERENCES:
1. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2016.
2. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, 2nd Edition, New Delhi, 2008.

		L	T	P	C
20CE711	**COMPUTER AIDED ANALYSIS, DESIGN AND DRAFTING LABORATORY (CADD)**	**0**	**0**	**4**	**2**

OBJECTIVES:
- To impart knowledge and skills to analyze structural elements using computer software.
- To give exposure to the analysis and design of industrial structures using computer software.
- To instill knowledge on the design and detailing of water tanks, and retaining walls.

LIST OF EXPERIMENTS
1. Introduction to STADD Pro
2. Analysis of simply supported beams using STADD Pro.
3. Analysis of fixed beams using STADD Pro.
4. Analysis and design of steel trusses using STADD Pro.
5. Analysis of single bay 2-D portal frame using STADD Pro.
6. Analysis and design of G+2 building using STADD Pro.
7. Design and drawing of RCC Cantilever type Retaining wall with reinforcement details.
8. Design and drawing of RCC Counterfort type Retaining wall with reinforcement details.
9. Design and detailing of circular water tank with reinforcement details.
10. Design and detailing of the rectangular water tank with reinforcement details.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1 Analyze different beams using STADD Pro.
CO2 Analyze and design steel truss using STADD Pro.
CO3 Analyze and design frames using STADD Pro.
CO4 Draw the structural detailing of RCC Cantilever type Retaining wall.
CO5 Draw the structural detailing of RCC Counterfort type Retaining wall.
CO6 Draw the structural detailing of Circular and Rectangular water tank.

REFERENCES
1. STAAD.Pro Technical Reference Manual Last updated: 19 November 2012

2. Krishna Raju, "Structural Design & Drawing (Concrete & Steel)", Universities Press; 3rd Edition 2021.
3. Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Design of steel structures", Lakshmi publications Pvt. Ltd 2017.
4. IS 456(2000) Indian Standard Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi.
5. SP34 Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

20CE712	DATA ANALYSIS AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart knowledge on the advanced functions in the excel program.
- To give exposure to data analysis and validation and report preparation.
- To provide knowledge on the effective usage of macros.

TOPICS:

1. Basics of Excel

Introduction to excel - Enter and edit data - Move around the Excel screen - Copy and move data - Write and apply formulas - Insert commonly used functions - SUM and AVERAGE - MAX and MIN – COUNT - Format the spreadsheet - Print the spreadsheet - Create and print charts.

2. Working with Functions

Conditional expressions - logical functions (AND, OR, NOT) - lookup and reference functions - VlookUP with Exact Match, Approximate Match - Nested VlookUP with Exact Match - VLookUP to consolidate Data from Multiple Sheets.

3. Sorting, Filtering and Data Validations

Sorting: Sorting tables - multiple-level and custom sorting, Filtering: Filtering data for selected view (AutoFilter) – Advanced filter options, Data Validations: Specifying a valid range of values for a cell - a list of valid values for a cell - custom validations based on formula for a cell.

4. Pivot tables and Charts

Pivot tables: Formatting and customizing Pivot tables – advanced options – Pivot charts – Consolidation of data from multiple sheets and files – external data sources, Charts: 3D Graphs – Bar and Line chart together – Primary and secondary axis – Sharing with MS PowerPoint and MS Word.

5. Reports and Templates

Reports: Creating subtotals and Multiple-level subtotals, Templates: designing the structure of the template – standardization of worksheets. Create Hyperlinks to files, web pages or to locations in the workbook

6. Macros and VBA

Record and run Macros - Add Toolbar buttons -View the VBA code

LIST OF EXERCISES:

1. Detailed analysis of a given set of data (sum, average, maximum, minimum, etc.)
2. To extract specific data from whole database using LOOKUP
3. Sorting, filtering and validation of a given set of data
4. Comparison of data using Pivot charts. (Bar chart, Pie chart)
5. Report preparation using mail merge
6. Unit conversion using macros. (FPS to MKS)

7. Create a macro which opens a Word document and puts mail merge fields at the right bookmark locations.
8. Write a macro which asks for your name using INPUTBOX and then displays a welcome message using MsgBox.
9. Use MsgBox to display a message asking a question and processing the answer.
10. Population forecasting using logical functions.
11. Determine the Shear force values for the given Simply supported beam and plot the SFD.
12. Determine the Bending Moment values for the given Simply supported beam and plot the BMD.
13. Design the given slab (one way slab/two-way slab) as per IS 456 -2000.
14. Quantity estimation of a given structure using mathematical operations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Identify suitable functions to be used to solve the given problem.
CO2 Apply logical functions to solve real time problems
CO3 Validate the given data using various functions like Sorting, Filtering, etc.
CO4 Summarize large amounts of data using pivot tables and charts.
CO5 Create reports using mail merge option.
CO6 Develop worksheets using macros and VBA.

REFERENCES:

1. Naveen Mishra, 'Excel with Microsoft Excel: Comprehensive & Easy Guide to Learn Advanced MS Excel' published by Penman Books, 2019.
2. Webster Tyler, 'Excel 2022: A Step-By-Step Approach to Learning the Fundamentals of Excel Grasping Advanced Features like Business Modelling, Sampling Design and Numerous Data Analysis Techniques', 2021.
3. Kathy K. Montoya, 'Definitive Guide to Microsoft Excel 2021/2022: A Comprehensive fresher to Expert User Guide to Learn Microsoft Excel with the New Features, Formulas, Essential Functions, Shortcuts, Tips and Tricks', Church Gate Publishing House, 2021.
4. Learn Excel - Free Online Excel Training: https://trumpexcel.com/learn-excel/
5. Wise Owl Training: https://www.wiseowl.co.uk/vba-macros/exercises/excel-vba/

		L	T	P	C
20CE713	**SUMMER INTERNSHIP**	**0**	**0**	**0**	**1**

OBJECTIVES:

- To enhance knowledge in professional engineering practices through industrial training on the latest technological developments.
- To create practical awareness for developing problem solving skills to the real time applications.
- To impart practical knowledge by involving in industrial projects.

STRATEGY:

The students individually undertake training in reputed civil engineering companies for a maximum period of four weeks. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated based on the presentation during the viva voce examination.

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Bridge the gap between Industrial requirements and academic learning.
- **CO2** Apply acquired knowledge to real-time applications.
- **CO3** Carryout multi-disciplinary projects under the guidance of industry and academic supervision.
- **CO4** Extend the knowledge through research and development in specialized areas.
- **CO5** Understand the intricacies involved in solving complex engineering problems.
- **CO6** Exposed to industrial culture and team work.

EVALUATION PROCEDURE

The method of evaluation will be as follows:

1.Project report	: 40 marks
2.Presentation	: 40 marks
3.viva-voce	: 20 marks

SEMESTER VIII

		L	T	P	C
20CE811	**PROJECT WORK**	**0**	**0**	**20**	**10**

OBJECTIVES:

- To develop the ability to apply the acquired knowledge to solve various civil engineering problems.
- To review literature in the topic of interest and formulate methodology to arrive at a feasible solution.
- To inculcate team spirit and enhance the communication and presentation skills.

STRATEGY:

- A student or a group of students (maximum 4) has to identify a topic of interest in consultation with faculty supervisor.
- They review the literature and gather information pertaining to the chosen topic and state the objectives and develop a methodology to achieve the objectives.
- Based on the topic, experimental investigation/ software analysis/ analytical modelling will be carried out.
- The results will be analyzed with a concluding remark to correlate the objectives.
- A comprehensive report will be prepared after completing the project.
- Evaluation will be done based on the performance in the periodic reviews, project report and viva voce examination.

TOTAL: 240 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Develop sustainable projects understanding the societal and environmental importance.
CO2	Identify appropriate techniques and apply fundamental engineering knowledge to solve the identified problem.
CO3	Carry out inter disciplinary projects using modern techniques and tools.
CO4	Work as an individual or as a team in the development of technical projects, applying ethical principles.
CO5	Comprehend and write reports effectively on the project related activities and findings.
CO6	Bridge the gap between industry and academia by carrying out industrial projects

PROFESSIONAL ELECTIVE (PE)

SEMESTER V
ELECTIVE -I

		L	T	P	C
20CE901	**FORMWORK ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on selection of materials for different formwork systems.
- To develop the conceptual knowledge of planning, design, and erection of formwork.
- To expose the formwork failures and issues in construction.

UNIT I INTRODUCTION **9**

Introduction –Formwork, scaffolding systems, types of form work, Construction planning and site constraints, Materials and construction of the common formwork systems, Planning for maximum reuse – Economical form construction, Special and proprietary forms. Formwork Accessories - Hardware and fasteners - Nails in Plywood.

UNIT II PLANNING OF FORMWORK **7**

Selection of right formwork - Duration & Cycle time - Scope, Catering area & Repetition-Bill of quantities- Productivity- Material planning- Labour planning- Equipment planning.

UNIT III PRESSURE OF CONCRETE ON FORMWORK **10**

Behaviour of concrete – concrete density - height of discharge – Temperature – Rate of Placing – Consistency of concrete - lateral pressure of concrete on formwork – wall forms – column forms - Effect of Weight of Concrete on Pressure- Vertical Loads on Forms.

UNIT IV DESIGN OF FORMS **12**

Design Principles - Allowable stresses - Design of Wall forms - Slab forms - Beam forms - Column forms - Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Sky deck and Multi flex - Customized slab table - Standard Table module forms - Heavy Duty props.

UNIT V FAILURES OF FORMWORK **7**

Causes of Failures of Formwork - case studies in formwork failure - Prevention of Formwork Failures- safety measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Select suitable material for different formwork systems.
CO2 Identify suitable type of formwork and plan for material, labour and equipment.
CO3 Calculate the pressure on formwork under different loading conditions.
CO4 Design formwork system for horizontal structural members.
CO5 Design formwork system for vertical structural members.
CO6 Assess the failures in formwork system and provide remedial measures.

TEXTBOOKS:

1. Kumar. Neeraj Jha, “Formwork for Concrete Structures”, McGraw Hill Education, New Delhi, 2017
2. Leonard Koel, “Concrete Formwork”, American Technical Publisher, USA. 2015.

REFERENCES:

1. Oberlender G.D and Peurifoy R. L. "Formwork of Concrete Structures" 4th Edition McGraw Hill Education, New Delhi. 2010.
2. Austin, C K., Formwork for concrete, Cleaver- Hume Press, London, 1960.
3. Christopher Souder, "Temporary Structure Design", Wiley Publications, London. 2014.
4. IS 14687: 1999- False work for Concrete Structures- Guidelines, BIS.
5. ACI 347R-14: Guide to Formwork for Concrete, ACI Committee 347, American Concrete Institute.

20CE902	ENGINEERING HYDROLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on components of hydrological cycle, spatial and temporal measurements of rainfall.
- To give an exposure on derivation and analysis of hydrographs.
- To introduce methods of flood routing and ground water hydrology.

UNIT I PRECIPITATION 9

Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of point rainfall – Intensity, duration, frequency relationship – Probable maximum precipitation.

UNIT II ABSTRACTION FROM PRECIPITATION 9

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of infiltration – Infiltration indices – Effective rainfall.

UNIT III HYDROGRAPHS 9

Factors affecting Hydrograph – Baseflow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different deviations - Synthetic Unit Hydrograph.

UNIT IV FLOODS AND FLOOD ROUTING 9

Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir flood routing – Muskingum's Channel Routing – Flood control.

UNIT V GROUND WATER HYDROLOGY 9

Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – Pumping test – Steady flow analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand concepts of hydrologic cycle, hydrometeorology and precipitation.
CO2	Apply various methods of field measurements and empirical formulae for estimating various losses of precipitation.
CO3	Demonstrate different types of hydrographs and their applications.
CO4	Explain flood routing methods and flood control measures.
CO5	Describe groundwater and hydraulics of subsurface flows.
CO6	Apply the knowledge of hydrology for water resources management.

TEXTBOOKS:

1. Subramanya, K., "Engineering Hydrology", Tata McGraw-Hill Publishing Co., Ltd., 2017.
2. Raghunath, H.M., "Hydrology: Principles, Analysis, Design", New Age International Publishers., 2015.

3. Jayarami Reddy.P. "Hydrology", Tata McGraw Hill, 2016.

REFERENCES:

1. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 2017.
2. Singh, V.P., "Engineering Hydrology", McGraw-Hill Inc., Ltd., 2019.

		L	T	P	C
20CE903	**ADVANCED SURVEYING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To familiarize the techniques of surveying using Total Station.
- To provide an understanding on the principles, methods and applications of remote sensing for surveying and mapping the topography.
- To impart knowledge on the concepts of space-based positioning system.

UNIT I TOTAL STATION SURVEYING 8

Fundamental quantities- Parts and accessories – Classifications -Electro-optical system - Microwave system: Working principle, Sources of Error - Comparison between Electro-optical and Microwave system - Infrared and Laser Total Station instruments - Care and maintenance of Total Station instruments- Software applications - Robotic Total Station.

UNIT II REMOTE SENSING AND ELECTROMAGNETIC RADIATION 10

Definition – components of RS – History of Remote Sensing - Electromagnetic Spectrum- Radiation sources: active & passive- Standard atmospheric profile – Atmospheric regions and its characteristics – Interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water.

UNIT III PLATFORMS AND SENSING TECHNIQUES 10

Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites - Classification of remote sensing sensors – Resolution: spatial, spectral, radiometric and temporal resolution - Scanners - Along and across track scanners – Optical-Infrared sensors – Thermal sensors – Microwave sensors – LIDAR.

UNIT IV UAV SURVEYING 9

Components of a drone - Introduction to Photogrammetry, Digital Photogrammetry – Mission planning and data acquisition - Data Processing, Data Extraction - Structure from Motion (SfM) Geometric modelling of terrain -Applications of drones in slope monitoring, Stockpile Volumetric Measurements, Land surveying and management, Urban planning, Disaster management- Case studies.

UNIT V GPS SURVEYING 8

GPS Surveying: Different segments – space, control and user segments – Satellite configuration – signal structure – Anti Spoofing and Selective Availability – Hand Held and Geodetic receivers – data processing – Traversing and triangulation – Planning and data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Outline the concept, principles and applications of total station in surveying.
CO2	Deduce the Landuse-Landcover features by comparing the spectral reflectance curve of Electromagnetic radiation with various objects on the Earth surface.

CO3	Summarize the components, platforms and different sensors used in remote sensing for earth observation.
CO4	Explain the principles of digital photogrammetry and the steps involved in mission planning to data extraction in drone surveying.
CO5	Appraise the applications of unmanned aerial vehicles in various facets of planning and management.
CO6	Describe the segments, planning and data acquisition in GPS surveying.

TEXTBOOKS:

1. Satheesh Gopi, R.Sathikumar, N. Madhu, "Advanced Surveying, Total Station, GPS, GIS and Remote Sensing" Pearson education, 2018.
2. Punmia. B. C., Ashok K. Jain and Arun K Jain, "Higher Surveying", Lakshmi Publications Pvt Ltd, New Delhi, 2016.

REFERENCES:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, "Remote Sensing and Image interpretation" John Wiley and Sons, Inc, New York, 2015.
2. Alfred Leick, "GPS Satellite Surveying", John Wiley & Sons, Inc., 4th Edition, 2015.
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 3rd Edition,2016
4. Daniel Tal, Jon Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 1st Edition, John Wiley and Sons Inc.,2021
5. Felipe Gonzalez Toro, Antonios Tsourdos, "UAV or Drones for Remote Sensing Applications in GPS/GNSS Enabled and GPS/GNSS Denied Environments", Printed Edition of the special issue published in Sensors, MDPI AG, 2021.

20CE904	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give awareness on vulnerability, disasters, disaster prevention and risk reduction.
- To introduce various approaches of disaster risk management strategies.
- To create exposure on disaster management case studies.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire etc., - Classification, Causes, Impacts of Disaster - Global trends in disasters: urban disasters, pandemics, complex emergencies, Do's and Don'ts during various types of Disasters – Role of Civil Engineers in Disaster Management.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Community based DRR, Structural – non-structural Mitigation measures, Early Warning System –Community Based Early Warning System, Contingency Planning, Disaster Recovery Planning.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, Impact of Development projects such as dams, embankments, changes in Land - use etc. - Climate Change Adaptation and Mitigation - IPCC Scenario and Scenarios in the context of India - Indigenous knowledge - Case Studies.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief, Policy Framework for

Disaster Management, Objectives of National Policy on Disaster Management, Organizational Structure at Central level and State Level - Role of GIS and Information Technology in Disaster Management Cycle - Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

Case Studies on Structural Assessment of Damaged buildings – Fire, Earthquake - Drought Assessment: Case Studies - Coastal Flooding: Storm Surge Assessment - Floods: Fluvial and Pluvial Flooding - Case Studies - Forest Fire: Case Studies, Man Made disasters: Case Studies, Tsunami: Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Describe the various types of disaster and the role of civil engineers in disaster management.
CO2	Interpret the phases of disaster management cycle and the approaches to disaster risk reduction.
CO3	Analyze the impacts of disaster and vulnerability factors.
CO4	Evaluate the disaster risk management strategies.
CO5	Assess the technologies to manage the risks from disaster.
CO6	Investigate the vulnerability factors and mitigation measures from various case studies.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427, ISBN-13: 978-9380386423.
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361
3. Subramanian R, "Disaster Management", Vikas Publishing House Pvt. Ltd.,2018. ISBN:978-93-5271-870-2.

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.
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.
5. https://www.ndmindia.mha.gov.in
6. https://www.ndma.gov.in

		L	T	P	C
20CE905	**HOUSING PLANNING AND ARCHITECTURE**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the fundamental concepts of housing planning and architecture.
- To introduce the principles and functional design of buildings relating to the environment and climate.
- To give exposure on project appraisal of housing projects.

UNIT I INTRODUCTION TO HOUSING AND ARCHITECTURE 9

Definition of Basic Terms - House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies including Slum Housing

Policy, Principle of Sustainable Housing - Architectural Design - an analysis - Introduction to basic elements and principles of design.

UNIT II PLANNING AND DESIGN OF HOUSING PROJECTS 9

Formulation of Housing Projects – Land Use and Soil suitability analysis - Building Byelaws and Rules and Development Control Regulations - Site Analysis, Layout Design, Design of Housing Units – Housing Project Formulation.

UNIT III BUILDING TYPES 9

Residential, Institutional, Commercial and Industrial – Application of anthropometry and space standards-Inter relationships of functions – Safety standards – Building rules and regulations – Integration of building services – Interior design.

UNIT IV CLIMATE AND ENVIRONMENTAL RESPONSIVE DESIGN 9

Environment and human interaction- Factors that determine climate – Characteristics of climate types – Design for various climate types – Passive and active energy controls – Green building concept.

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL 9

Evaluation of Housing Projects for sustainable principles – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy- Public Private Partnership Projects – Viability Gap Funding - Pricing of Housing Units.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Apply knowledge on housing policies and architectural design principles.
CO2	Plan and design the housing projects as per D.C. regulations.
CO3	Evaluate building rules and regulations, safety standards and integration of building services.
CO4	Analyse the characteristics of climate types by passive and active energy controls.
CO5	Perform the economic analysis based on project appraisal of housing projects.
CO6	Formulate and design the housing layouts by conducting site analysis.

TEXT BOOKS:

1. Muthu Shoba Mohan.G, “Principles of Architecture”, Oxford University Press, New Delhi, 2018.
2. Meera Mehta and Dinesh Mehta, "Metropolitan Housing Markets", Sage Publications Pvt. Ltd., New Delhi, 1999.
3. Francis Cherunilam and Odeyar D Heggade, "Housing in India", Himalaya Publishing House, Bombay, 1997.

REFERENCES:

1. Pramar. V.S. “Design fundamental in Architecture”, Somaiya Publications Pvt. Ltd., New Delhi, 1997.
2. Arvind Krishnan, Nick Baker, Simos Yannas, Szokolay.S.V, “Climate Responsive Architecture”, A Design Hand Book for Energy Efficient Building, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
3. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2004.
4. Government of India, National Housing Policy, 1994
5. National Building Code of India. SP7 (Group 1) Bureau of Indian Standards, New Delhi, 2005.

		L	T	P	C
20ME926	**PRINCIPLES OF MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

Students completing this course are expected to:

- Understand the roles of Management and the principles of an organization.
- Discuss the functions and responsibilities of managers.
- Demonstrate the tools and techniques to be used in the performance of the managerial job.
- Analyze and understand the environment of the organization.
- Develop the cognizance of the importance of management principles.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art– Manager Vs Entrepreneur - types of managers-managerial roles and skills– Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization-Sole proprietorship, partnership, company- public and private sector enterprises-Organization culture and Environment– Current trends and issues in Management. Fundamentals of Entrepreneurship, Circular flow of income.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies –Planning premises – Strategic Management –Planning Tools and Techniques– Decision making steps and process - strategic technology planning

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure

– types – Line and staff authority–departmentalization–delegation of authority– centralization and decentralization–Job Design-Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management. Managing personnel records

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction–job enrichment–leadership–types and theories of leadership–communication–process of communication–barrier in communication– effective communication–communication and IT. Organizational behaviour

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting .SQC techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1	Understand the management thoughts and various challenges of managerial activities in a global business environment.
CO2	Demonstrate the various strategies in Decision making at various levels management in the Organizations.
CO3	Discuss the various types of Organization structure.
CO4	Describe the steps in Staffing process and stages in Career development.
CO5	Explain the elements in Direction.
CO6	Summarise the various Controlling techniques to maintain standards in Organizations.

TEXT BOOKS:

1. Koontz, H, & Weihrich, H (2016). Essentials of Management: An International Perspective (8th ed.), Tata McGraw Hills, New Delhi..
2. Ghuman, K & Aswathapa, K, (2017). Management concepts and cases (10th ed.), Tata McGraw Hills, New Delhi.
3. Telsan, M.T. (2016). Industrial and Business Management, (4th ed.), S. Chand, New Delhi.

REFERENCES:

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Saxena, P.K., Principles of Management: A Modern Approach, Global India Publications. (2016).

PROFESSIONAL ELECTIVE (PE)

SEMESTER VI
ELECTIVE -II

		L	T	P	C
20CE906	**CONSTRUCTION PLANNING AND SCHEDULING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To give an overview about construction planning.
- To introduce scheduling techniques and monitoring of cost control in construction.
- To create awareness on quality control, safety and management information system.

UNIT I CONSTRUCTION PLANNING 9

Basic concepts in the development of construction plans-Choice of Technology and Construction method - Defining Work Tasks- Work breakdown structure- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.

UNIT II SCHEDULING PROCEDURES AND TECHNIQUES 9

Relevance of construction schedules - Bar charts - The critical path method - PERT method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows - Calculations for scheduling with leads, lags and windows-Resource oriented scheduling - Scheduling with resource constraints and precedence -Use of Advanced Scheduling Techniques - Scheduling with uncertain durations-Crashing and time/cost tradeoffs -Improving the Scheduling process – Introduction to application software.

UNIT III COST CONTROL MONITORING AND ACCOUNTING 9

The cost control problem-The project budget-Forecasting for Activity cost control - financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule and Budget updates -Relating cost and schedule information.

UNIT IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9

Quality and safety Concerns in Construction-Organizing for Quality and Safety - Work and Material Specifications - Total Quality control -Quality control by statistical methods - Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

UNIT V ORGANIZATION AND USE OF PROJECT INFORMATION 9

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information - Organizing information in databases - Relational model of Data bases -Other

conceptual Models of Databases - Centralized database Management systems - Databases and application programs-Information transfer and Flow.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Understand the basic concepts of construction planning exercised in construction projects.
- **CO2** Choose suitable scheduling technique for the particular project.
- **CO3** Practice the cost control systems and techniques adopted.
- **CO4** Employ the quality control and safety during construction.
- **CO5** Explain the information and accuracy of construction projects.
- **CO6** Organize the information in centralized database management systems.

TEXT BOOKS:

1. Chitkara, K.K. "Construction Project Management Planning, Scheduling and Control", Tata McGraw-Hill Publishing Co., New Delhi, 2010.
2. Virendra Kumar Paul, "A handbook for Construction Project Planning and Scheduling", Copal Publishing Company Ltd, 2017.

REFERENCES:

1. Thomas E. Glavinich, "Construction Planning and Scheduling", University of Kansas, 2nd Edition, 2017.
2. Jimmie Hinze, "Construction Planning and Scheduling", Pearson Publishing Company Ltd., 2013.
3. Srinath,L.S., "Pert and CPM Principles and Applications", Affiliated East West Press, 2001.
4. Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamentals Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pitsburgh, 2000.
5. Halpin, D. W., "Financial and Cost Concepts for Construction Management", John Wiley & Sons, New York, 2009.

		L	T	P	C
20CE907	**GROUND IMPROVEMENT TECHNIQUES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the characteristics of problematic soils and suggest a suitable type of ground improvement technique for a particular site and structure.
- To give exposure on the in-situ treatment methods for cohesive and cohesionless soils.
- To create understanding on the importance of geotextile applications in road works and containments.

UNIT I PROBLEMATIC SOILS AND SELECTION OF IMPROVEMENT TECHNIQUES **9**

Geotechnical problems in alluvial, lateritic and black cotton soils - Need and objectives of ground Improvement in foundation engineering – Classification of ground modification techniques – Selection of suitable ground improvement techniques based on soil conditions.

UNIT II HYDRAULIC MODIFICATION **9**

Methods of Dewatering techniques - Open sumps and ditches- Well point system – Vacuum and electro osmotic methods – pre-loading with sand drains - strip drains – vertical drains- Simple design - Seepage analysis for two-dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design of filters

UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS 9

Principles of Mechanical Modifications in cohesionless soils – Shallow and deep compaction – Dynamic compaction –Vibro-floatation, Blasting, Dynamic consolidation, pre-compression and compaction piles- Consolidation of cohesionless soils – lime stabilization - Stabilization of soft clay using stone and lime columns – Lime- fly ash columns - Lime piles- Installation techniques – Simple design - soil improvement by thermal treatment - Relative merits and limitations of above methods.

UNIT IV REINFORCED EARTH AND GEOSYNTHETICS 9

Concept of soil reinforcement - Reinforcing materials- Backfill criteria- Reinforced earth wall – Mechanism – Simple design - Applications of Reinforced earth structures –Ground anchors - Soil nailing and Applications- Overview on Geosynthetics – Geotextiles, Functions and Applications – Geogrids – Types and applications

UNIT V PHYSICAL AND CHEMICAL MODIFICATION 9

Grouting – Types – Equipment and machinery – Injection methods – Grout monitoring - Stabilization with admixtures like cement, lime, fly ash and bitumen and chemicals – Stabilization of expansive soil.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Identify issues related to soil deposits and develop strategies to assess them.
CO2	Familiarize with various ground improvement techniques and selection of appropriate methods suited to soil conditions
CO3	Understand dewatering techniques and demonstrate the ability to design a dewatering system according to the requirements.
CO4	Gain knowledge on in-situ treatment of cohesive and cohesionless soils.
CO5	Understand the concept of reinforced earth structures, geosynthetics, geotextiles, geogrids and their applications.
CO6	Gain knowledge on types of grouting and different soil stabilization techniques.

TEXTBOOKS:

1. Purushothama Raj. P, "Ground Improvement Techniques", Lakshmi Publications, 2nd Edition, 2016.
2. Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering", McGraw Hill, 1994.

REFERENCES:

1. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House, 1st Edition, 2012.
2. Mittal S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, 1st Edition, 2013.
3. Bikash Chandra Chattopadhyay and Joyanta Maity, "Ground Improvement Techniques" PHI Learning; Eastern Economy Edition, 2017.
4. Koerner, R.M., "Designing with Geosynthetics" (Fourth Edition), Prentice Hall, Jersey, 2012.
5. Jones C.J.F.P, "Earth Reinforcement and Soil Structure", Thomas Telford Publishing, 1996.

		L	T	P	C
20CE908	**MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To acquire knowledge on various facets of maintenance and damage assessment.
- To acquire knowledge on special concrete and quality assurance, strength and durability aspects.
- To understand the assessment of distressed structures, repair and protection methods and demolition procedures.

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation – Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete – Strength, Durability, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated, Corrosion - Effects of cover thickness.

UNIT III SPECIAL CONCRETE 9

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete - High performance concrete - Vacuum concrete - Self compacting concrete – Geopolymer concrete - Reactive powder concrete - Concrete made with industrial wastes.

UNIT IV TECHNIQUES FOR REPAIR AND PROTECTION METHODS 9

Non-destructive Testing techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Demolition techniques - Engineered demolition methods - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Understand the importance of maintenance, inspection and assessment methods of distressed structures.
- **CO2** Discuss the effects of climate and temperature on the strength and durability properties of concrete.
- **CO3** Describe different types of special concrete and its properties.
- **CO4** Explain the various techniques for repair rand protection methods.
- **CO5** Identify the repair, rehabilitation and retrofitting methods for different structures.
- **CO6** Understand various methods of demolition techniques through case studies.

TEXTBOOKS:

1. Shetty.M.S., Jain A K.,"Concrete Technology -Theory and Practice", 8th Edition, S.Chand and Company , 2019.
2. B.Vidivelli, "Rehabilitation of Concrete Structures", 1st Edition/ Reprint: 2015, Standard Publisher Distributors, 2009.

REFERENCES:

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD, Government of India, New Delhi 2002.
3. P.C.Varghese, "Maintenance Repair and Rehabilitation & Minor works of building", Prentice Hall India Pvt Ltd 2014.
4. R. Dodge Woodson, "Concrete Structures, Protection, Repair and Rehabilitation", Butterworth-Heinemann, Elsevier, New Delhi 2012.

20CE909	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an understanding of the terminologies used in urban planning.
- To introduce the laws and legislations with respect to urban planning and development.
- To create awareness on the strategies involved in planning of small towns to smart cities.

UNIT I BASIC TERMINLOGIES 8

Definition of Human settlement, Urban area, Town, City, Urbanization, Suburbanization, Urban sprawl, Peri-urban areas, Central Business District (CBD) - Classification of urban areas – Trend of Urbanization at International, National, Regional and State level.

UNIT II URBAN PLANNING 8

Principles of Planning – Types and Level of Plan - Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design.

UNIT III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION 10

Scope and Content of Regional Plan, Master Plan, Detailed Development Plan - Development Control Rules - Transfer of Development Rights - Special Economic Zones- Development of small town and smart cities-case studies.

UNIT IV PLANNING AND DESIGN OF URBAN DEVELOPMENT PROJECTS 9

Site Analysis - Layout Design - Planning Standards - Project Formulation – Evaluation, Plan Implementation, Constraints - Financing of Urban Development Projects.

UNIT V LEGISLATION, DEVELOPMENT AND MANAGEMENT OF URBAN SYSTEM 10

Town and Country Planning Act - Land Acquisition and Resettlement Act - Urban Planning Standards and Regulations - Involvement of Public, Private, NGO, CBO and Beneficiaries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the terminologies involved in urban planning and urbanization.
CO2	Explain the goals, objectives and stages involved in the urban planning process.
CO3	Discuss the content regional plan, master plan and control rules in the context of urban development plans.
CO4	Appraise the development plans of small towns to smart cities.
CO5	Describe the financing policies of urban development projects.
CO6	Summarize the rules and legislation involved in urban planning.

TEXTBOOKS:

1. S. L. Goel and S. S. Dhaliwal“S.L Urban Development and Management” Deep and Deep publications, New Delhi, 2002.
2. George Chadwick, “A Systems view of planning” Pergamon press, Oxford 1978.

REFERENCES:

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai
2. S. K. Kulshrestha, “Urban and Regional Planning in India: A Handbook for Professional Practice” SAGE Publications, 2012
3. Chennai Metropolitan Development Authority (CMDA) Second Master Plan for Chennai, Chennai 2008

4. Singh V.B, “Revitalised Urban Administration in India” Kalpaz publication, Delhi, 2002.
5. Edwin S.Mills and Charles M.Becker, “Studies in Urban development” A World Bank publication, 1986

20CE910	ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview on the developments in environmental impact assessment.
- To introduce the concept of environmental assessment models at global level.
- To familiarize the environmental impacts on infrastructure projects.

UNIT I INTRODUCTION **9**

Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants.

UNIT II ENVIRONMENTAL ASSESSMENT **9**

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Check list methods - Mathematical models for impact prediction – Analysis of alternatives.

UNIT III ENVIRONMENTAL MANAGEMENT PLAN **9**

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Public Hearing-Environmental clearance- Post Project Monitoring.

UNIT IV SOCIO ECONOMIC ASSESSMENT **9**

Baseline monitoring of socio-economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit analysis.

UNIT V CASE STUDIES **9**

EIA case studies pertaining to infrastructure projects – Real Estate Development - Roads and Bridges – Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Power plants – CETPs- Waste processing and disposal facilities – Mining projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Summarize the principles, objectives and legislation of environmental impact assessment consultants.
CO2	Demonstrate the use of mathematical models for impact prediction in various environmental aspects.
CO3	Interpret the EIA reports to suggest suitable mitigation measures.
CO4	Enumerate the role of public participation in environmental decision-making process.
CO5	Estimate the impact of developmental projects in the socio-economic sector.
CO6	Appraise the use of EIA in various aspects of environment to predict the impact of infrastructure development.

TEXTBOOKS:

1. Canter, L.R., "Environmental Impact Assessment", McGraw Hill, New Delhi, 1996.
2. Meenakshi. P, "Elements of Environmental Science and Engineering", Prentice Hall of India, New Delhi, 2012.

REFERENCES:

1. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme 2002.
2. Judith Petts, "Handbook of Environmental Impact Assessment" Vol. I and II, Blackwell Science, New York, 1999.
3. "Ministry of Environment and Forests, EIA Notification and Sectoral Guides, Government of India", New Delhi, 2010.
4. Peter Morris, Riki Therivel, "Methods of Environmental Impact Assessment", Routledge Publishers 2009.

		L	T	P	C
20ME927	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

Students completing this course are expected to:

- Understand the techniques for the implementation of quality management in manufacturing and services processes.
- Explain the Quality Management principles and process.
- Discuss the importance of Quality in an organization.
- Understand the ISO Quality systems.
- Summarise the quality concepts adopted in industry scenario.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention

UNIT II TQM PRINCIPLES **9**

Leadership – Quality Statements, Strategic quality planning, Quality Councils - Employee involvement- Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S and case study, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - new management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process – FMEA and Applications in the Industry - Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality Circles, Cost of Quality, Quality Function Development (QFD) and case study- Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V CASE STUDIES **9**

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector-Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements – Implementation –

Documentation - Internal Audits - Registration- Environmental Management System: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the quality philosophies and customer focused managerial system
CO2	Summarize the quality management principles
CO3	Apply the six sigma concepts in manufacturing and service sector
CO4	Determine the tools and techniques for quality improvement.
CO5	Discuss the standards and auditing system on implementation of TQM.
CO6	Analyze standards for the operation of EMS

TEXTBOOKS:

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2020.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2019.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2018.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2020.
4. ISO 9001-2015 standards

PROFESSIONAL ELECTIVE (PE)

SEMESTER VII
ELECTIVE –III

		L	T	P	C
20CE911	**PREFABRICATED STRUCTURES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the various concepts of prefabrication
- To introduce the design principles in prefabricated design
- To provide understanding on the behaviour of various structural elements and connections in prefabricated structures

UNIT I GENERAL PRINCIPLES OF PREFABRICATION 9

Comparison with monolithic construction – need for prefabrication – advantages and disadvantages – materials – modular coordination – standardization – Prefabrication Systems - manufacture, storage, transport and erection of precast elements as per IS 15916: 2010 - quality inspection - common defects and remedies

UNIT II PREFABRICATED ELEMENTS 9

Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

UNIT III DESIGN PRINCIPLES 9

Design loads – precast frame analysis – design considerations - problems on location of centre of mass and centre of stiffness and lateral force distribution

UNIT IV JOINTS AND CONNECTIONS 9

Definitions - basic mechanism - compression joints - shear joints - tension joints - pin-jointed connections - moment resisting connections: beam to column connection and column to foundation connection

UNIT V DESIGN FOR ABNORMAL LOADS 9

Progressive collapse – codal provisions – equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - importance of avoidance of progressive collapse.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Recall the various technologies used in fabrication and erection
CO2	Illustrate the behaviour of various components of prefabricated structure
CO3	Identify the various design loads to be considered in the design of elements
CO4	Calculate the centre of mass, centre of stiffness and lateral force distribution in a structure,
CO5	Identify suitable connections for different members
CO6	Propose suitable mechanism to avoid progressive collapse

TEXT BOOK:

1. Kim S Elliot, "Precast Concrete Structures", 2nd Edition, CRC Press, 2019
2. PCI Design Handbook: Precast and Prestressed Concrete, 7th Edition

REFERENCES:

1. Good Industry Practices Guide Book: Precast Concrete Elements. CONQUAS Enhancement Series
2. IS: 11447 – 1985: Code of practice for construction with large panel prefabricates
3. IS: 7922 – 1987: Recommendations for modular co-ordination in building industry: vertical co-ordination
4. IS :12073 - 1987: Recommendations for modular co-ordination: coordinating sizes for doorsets and windowsets
5. IS 15916: 2010: Building design and erection using prefabricated concrete - Code of practice

		L	T	P	C
20CE912	**PRESTRESSED CONCRETE STRUCTURES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on principles and different methods of prestressing
- To acquire knowledge on design of pre-tensioned and post-tensioned beams and prediction of deflection.
- To provide knowledge on analysis and design of composite beams, continuous beams, water tanks, prestressed concrete poles, and pipes.

UNIT I INTRODUCTION 9

Historical developments – Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems – Analysis of sections - stress concept, strength concept and load balancing concept – Losses of prestress in post -tensioned and pre-tensioned members.

UNIT II DESIGN FOR FLEXURE AND SHEAR 9

Basic assumptions for calculating flexural stresses – Permissible stresses in steel and concrete as per I.S.1343 Code – Design of sections of Type I and Type II post-tensioned and pre-tensioned beams – Check for strength limit based on I.S. 1343 Code – Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

UNIT III DEFLECTION AND DESIGN OF ANCHORAGE ZONE 9

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long-term deflections due to creep and shrinkage – Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and I.S. 1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

UNIT IV COMPOSITE BEAMS AND CONTINUOUS BEAMS 9

Analysis and design of composite beams - Shrinkage strain and its importance – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT V MISCELLANEOUS STRUCTURES 9

Design of tension and compression members – Design of water tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the principles and methods of prestressing and analyze sections using different methods beam and losses of prestress.
CO2	Design prestressed concrete members for flexure and shear as per the relevant design code.
CO3	Determine deflection, stresses in the anchorage zone and design of prestressed concrete members for serviceability.
CO4	Analyze and design composite beams and continuous beams.
CO5	Design prestressed concrete pipes, poles, tension and compression members.
CO6	Explain the principles of partial prestressing, its merits and demerits.

TEXTBOOKS:

1. Krishna Raju N., "Prestressed Concrete", 5th Edition, Tata McGraw Hill Company, 2012.
2. Pandit.G.S. And Gupta.S.P, "Prestressed Concrete", 2nd Edition, CBS Publishers and Distributers Pvt Ltd., 2014.

REFERENCES:

1. M.K.Hurst, "Prestressed Concrete Design" Second Edition, CRC Press, 2019
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2010.
3. Dayaratnam.P., Sarah P, "Prestressed Concrete Structures", Seventh Edition, Oxford and IBH, 2017.
4. Sinha.N.C. And Roy.S.K." Fundamentals of Prestressed Concrete", S.Chand and Co. Ltd., 2012.
5. IS 1343 (2012): Code of Practice for Prestressed Concrete.
6. IS 3370-Part 4: Code of practice for concrete structures for the storage of liquids.

20CE913	COMPUTER AIDED DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on software tools in drafting, analysis and design of structures
- To introduce optimization techniques and to develop algorithm for linear programming
- To introduce artificial intelligence and knowledge based expert systems

UNIT I INTRODUCTION 9

Fundamental reason for implementing CAD - Software requirements – Hardware components in CAD system – Design process - Applications and benefits.

UNIT II COMPUTER GRAPHICS 9

Graphic Software – Graphic primitives - Transformations - 2 Dimensional and 3 Dimensional transformations – Concatenation - Wire frame modeling - Solid modeling - Graphic standards - Drafting packages.

UNIT III STRUCTURAL ANALYSIS 9

Principles of structural analysis - Fundamentals of finite element analysis - Concepts of finite elements – Stiffness matrix formulation – Variational Method – Weighted residual method – Problems – Convergence criteria – Analysis packages and applications.

UNIT IV DESIGN AND OPTIMIZATION 9

Principles of design of steel and RC structures - Beams and Columns - Applications to simple design problems - Optimization techniques - Algorithms - Linear programming – Simplex Method.

UNIT V EXPERT SYSTEMS 9

Introduction to artificial intelligence - Knowledge based expert systems – Applications of Knowledge Based Expert Systems - Rules and decision tables - Inference mechanisms – simple applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the concepts of Computer-Aided Design, Software requirements and Hardware components in CAD system.
CO2	Acquire the knowledge in Computer Graphics and Computer aided drafting using Auto CAD software.
CO3	Understand the fundamentals of finite element analysis and be able use software for modeling, analysis and design of structures.
CO4	Understand the concepts of Optimization techniques and its practical applications to structural engineering.
CO5	Acquire the knowledge in Artificial Intelligence and Knowledge based expert systems.
CO6	Adopt CAD and Finite Element methods in the field

TEXT BOOK:

1. Srinivasa Prakash Regalla, "Computer Aided Analysis and Design" 1st Edition, Dreamtech Press; 2020
2. Narayan LK, Rao MK., "Computer Aided Design and Manufacturing", Delhi, India: PHI Learning; 2008.

3. Krishnamoorthy C S, Rajeev S , Rajaraman A., "Computer Aided Design: Software and Analytical Tools" 2nd Edition Alpha Science; January 30, 2005

REFERENCES:

1. Guerra A, Kiousis PD. "Design optimization of reinforced concrete structures" Computers & Concrete, Vol. 3, No. 5 (2006) 313-334 [Internet]. 2006 [cited 2022 Mar 4]; Available from: http://inside.mines.edu/~aguerra/Guerra_DesignOpt.pdf
2. Patterson DW, "Introduction to Artificial Intelligence", Pearson Education India, 6 January 2015.

20CE914	BUILDING SERVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give an overview to water supply distribution systems.
- To give exposure to design fundamentals of lighting and conveying systems.
- To introduce the design aspects related to air-conditioning, fire safety, fire detection, firefighting and acoustic systems.

UNIT I WATER SUPPLY DISTRIBUTION SYSTEMS 9

Distribution systems in small towns - Types of pipes used - Laying, jointing, testing - prevention of water wastage and reuse of water. Plumbing - Internal water supply layout in buildings, pipe, Planning and layout of water supply distribution in residences.

UNIT II LIGHTING SYSTEMS AND CONVEYING SYSTEMS 9

Lighting System: Basic Design Principles, Lighting for Office, Schools, Libraries, Residential, Hospital, Parking, Outdoor, Reducing electric loads, installation and maintenance – Energy efficient lighting, Lighting controls, Solar systems. Conveying System: Basic design Principles, criteria for planning sizing, selection and layout of vertical distribution systems – lifts, Escalators and moving walkways, Elevators - types of elevators - design criteria.

UNIT III AIR CONDITIONING: SYSTEMS AND DESIGN CRITERIA 9

Air conditioning system for small buildings – window types, evaporative cooler, packaged terminal units and through the wall units split system - Design criteria for selecting the Air conditioning system for large building and energy conservation measures - Typical choices for cooling systems for small and large buildings.

UNIT IV FIRE SAFETY: DESIGN AND GENERAL GUIDELINES OF EGRESS DESIGN - FIRE DETECTION AND FIRE FIGHTING 9

Fire safety design principles - NBC Planning considerations in buildings –General guidelines for egress design for Auditoriums, concert halls, theatres, other building types. Fire Detection and Fire Fighting: Heat smoke detectors – sprinkler systems – Firefighting pump and water requirements, storage – wet risers, Dry rises - Fire extinguishers & cabinets - Fire protection system - Fire alarm system.

UNIT V ACOUSTICS 9

Fundamentals – Sound waves, frequency, intensity, wave length, measure of sound, decibel scale, speech and music frequencies, Reverberation time. Acoustics and building design - site selection, shape, volume, treatment for interior surfaces, basic principles in designing open air theatres, cinemas, broadcasting studios, concert halls, lecture halls, schools, residences, office buildings.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Plan the residential water supply distribution system.
- **CO2** Assess the design principles of lighting systems.
- **CO3** Understand the design principles of conveying systems.
- **CO4** Illustrate the design aspects and selection of air conditioning system for various buildings.
- **CO5** Apply the design principles of fire safety, firefighting and fire detection systems.
- **CO6** Develop the acoustic design for various buildings.

TEXTBOOKS:

1. Punmia B.C., "Waste Water Engineering", Laxmi Publications, 2016.
2. George R. Strakosch (Editor), Robert S. Caporale, 'The Vertical Transportation Handbook' 4th Edition, Wiley and Sons, 2010.
3. Halpeth M K, Senthil kumar T, Harikumar G, "Light Right", TERI publications, 2009.
4. David Egan, "Architectural Acoustics", J.Ross Publishing, 2007.

REFERENCES:

1. Andrew H Buchanan; 'Structural Design for Fire Safety', Wiley, 2017.
2. Rangwala S C, "Water Supply and Sanitary Engineering", Charotar publishing house, 2019.
3. National Building Code of India, 2005.
4. National Lighting Code, 2010.

		L	T	P	C
20CE915	**INDUSTRIAL STRUCTURES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce planning, layout, functional aspects of industrial structures.
- To impart knowledge on the design of industrial structures using steel and reinforced concrete.
- To provide understanding on the basic principles of prefabrication and prestressing for industrial structures.

UNIT I PLANNING **9**

Classification of industries and industrial structures – Major components of industrial buildings- Industry sectors and classification- General requirements of various industries – Introduction to plant layouts- Objectives of plant layout- Importance of plant layout - classification of plant layout -Planning and layout of buildings and components- factors considered while selecting the site requirements and installation of the plant.

UNIT II FUNCTIONAL REQUIREMENTS **9**

Lighting- types of light sources – Ventilation and its types - Acoustics – Sources of noise- Sound absorbing materials- Noise and Vibration control –-Heat or ignition sources - Industrial fire and its prevention - Fire safety -Guidelines from factories act.

UNIT III DESIGN OF INDUSTRIAL STEEL STRUCTURES **9**

Industrial roofs – Design of plate girders - Design of steel Chimney – Pre-engineered and Mills buildings - Design of steel Bunkers and Silos.

UNIT IV DESIGN OF INDUSTRIAL R.C. STRUCTURES **9**

Design of RCC Silos and bunkers - Design of RCC Chimney- Principles and components of cooling towers – Factors affecting cooling tower performance.

UNIT V PREFABRICATION **9**

Principles of prefabrication and pre cast construction – Advantages and applications of

prefabrication Load distribution and types of prefabricated structures– Prestressed precast roof trusses - Functional requirements for Precast concrete units –Floor slabs - Wall panels- Handling and erection stresses- Joints in precast structures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Classify various industrial structures.
CO2	Plan and design the layout of industrial structures based on the functional requirements.
CO3	Design crane girders, industrial roofs, bunkers and silos using steel
CO4	Design chimneys, silos and bunkers using reinforced concrete.
CO5	Understand the concept of pre-engineered buildings and folded plates & shell roofs
CO6	Understand the principles of prefabrication and prestressing in industrial structures.

TEXTBOOKS:

1. Ramamrutham .S., "Design of reinforced Concrete Structures", Dhanpat Rai Publishing Company, 2016.
2. Bhavikatti S.S., "Design of Steel Structures", J.K. International Publishing House Pvt. Ltd., 2013.
3. Ashoke Kumar Dasgupta., "Design of Industrial Structures-Reinforced Cement Concrete and Steel" (First Edition), CRC Press. 2021

REFERENCES:

1. Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2007.
2. Handbook on Functional Requirements of Industrial buildings, SP32–1986, Bureau of Indian Standards, 2016.
3. Handbook on Precast construction, An Indian Concrete Institute Publication, 2016
4. IS 6665: Code of practice for Industrial Lighting, Bureau of Indian Standards BIS, 1972 (Reaffirmed 2020)

20CE916	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart conceptual knowledge on finite element analysis.
- To provide an understanding on the finite element modelling of 1-dimensional, 2-dimensional and iso-parametric elements.
- To give an exposure on application of finite element modelling to plate bending and fluid mechanics problems.

UNIT I INTRODUCTION TO FINITE ELEMENT ANALYSIS 9

Concepts of FEM – steps involved – merits and demerits – energy principles – Discretization – Raleigh – Ritz method of functional approximation. Principles of Elasticity: Stress equations – strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axi-symmetric loading.

UNIT II FINITE ELEMENT MODELLING 9

Stiffness matrix for bar and beam elements – shape functions for 1-D elements. Two-dimensional FEM: Different types of elements for plane stress and plane strain analysis – displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – geometric invariance – natural coordinate system – area and volume coordinates – generation of element stiffness and nodal load matrices,

UNIT III FE MODELLING OF ISOPARAMETRIC ELEMENTS 9

Concept – different iso-parametric elements for 2D analysis -formulation of 4-noded and 8-noded iso-parametric quadrilateral elements – Lagrange elements – serendipity elements. Axisymmetric Analysis: bodies of revolution – axisymmetric modelling – strain displacement relationship – formulation of axisymmetric elements. Three-dimensional FEM: Different 3-D elements-strain-displacement relationship –formulation of hexahedral and iso-parametric solid element.

UNIT IV FEM FOR FRAMES AND CONTINUOUS BEAMS 9

Stiffness of Truss Members - Analysis of Truss - Stiffness of Beam Members - Finite Element Analysis of Continuous Beam - Plane Frame Analysis.

UNIT V APPLICATIONS OF FEM 9

Plate Bending Problems - Finite Elements for Elastic Stability - Finite Elements in Fluid Mechanics - Dynamic Analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Understand the finite element formulation for different boundary conditions.
- **CO2** Determine stiffness matrix for 1 dimensional and 2 dimensional elements.
- **CO3** Model 2D and 3D iso-parametric and axisymmetric elements
- **CO4** Analyse truss, continuous beam and plane frame using finite element method
- **CO5** Apply the concept of finite element to plate bending and elastic stability problems
- **CO6** Apply the Finite element principle to Fluid mechanics problems.

TEXTBOOKS:

1. Chandrupatla,T.R., and Belegundu, A.D., “Introduction to Finite Element in Engineering”, 3rd Edition, Prentice Hall, India, 2003.
2. Krishnamoorthy C. S.,"Finite Element Analysis Theory and Programming", Tata McGraw Hill Education, 1994
3. David V. Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2004
4. Daryl L.Logan, "A First Course in Finite Element Method", Cengage Learning, 2012.

REFERENCES:

1. Reddy J.N.,“An Introduction to Finite Element Method”,McGraw-Hill, Intl. Student Edition,1985.
2. Zienkiewics, “The finite element method, Basic formulation and linear problems”, Vol.1, 4th Edition, McGraw-Hill, Book Co., 1987
3. Rao S.S, “The Finite Element Method in Engineering”, Pergaman Press, 2003.
4. Desai C.S. and. Abel J.F, “Introduction to the Finite Element Method”, Affiliated East West Press, 2000.
5. Cook R.D.,"Concepts and Applications of Finite Element Analysis", Wiley and Sons, 1989.

		L	T	P	C
20CE917	**PROFESSIONAL ETHICS IN ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To familiarize with Engineering Ethics and Human Values.
- To impart knowledge on codes of ethics, safety, responsibilities and rights of engineers.
- To create awareness on global issues related to environmental ethics, computer ethics, weapons development and corporate social responsibility

UNIT I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 8

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law - The Challenger Case Study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 10

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

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Summarize the importance of human values in work place.
CO2	Discuss the senses of engineering ethics, moral dilemmas, moral autonomy and uses of ethical theories.
CO3	Describe the role of engineers as responsible experimenters and necessity of codes of ethics in engineering.
CO4	Explain safety, risk, responsibilities and rights in the society.
CO5	Analyze the global issues related to environmental ethics, computer ethics, weapons development and the role of engineers as expert witnesses and advisors.
CO6	Apply ethics in society and discuss the ethical issues related to engineering.

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2012.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2018.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2012.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

PROFESSIONAL ELECTIVE (PE)

SEMESTER VII
ELECTIVE –IV

		L	T	P	C
20CE918	**FUNDAMENTALS OF STRUCTURAL DYNAMICS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the fundamental concepts of structural dynamics.
- To provide understanding on the response of single degree and multiple degree of freedom systems under dynamic loading.
- To familiarize the instruments used in vibration recording and monitoring.

UNIT I INTRODUCTION TO STRUCTURAL DYNAMICS 9

Introduction to Structural Dynamics - Modeling of Structural Components and Systems - Prototype Spring–Mass Model - Concept of inertia and damping – Types of Damping – Difference between static forces and dynamic excitation.

UNIT II SINGLE DEGREE OF FREEDOM SYSTEM 9

Definition of degree of freedom – Idealization of structure as Single Degree of Freedom (SDOF) system – Formulation of equation of motion for various SDOF system – D' Alembert's Principles – Effect of damping – Free and forced vibration of damped and undamped structures.

UNIT III RESPONSE OF SDOF SYSTEM 9

Response to harmonic forces and periodic forces - Response to general dynamic loading: Duhamel's integral undamped system (Constant, Rectangular & Triangular loads) - Duhamel's integral damped system.

UNIT IV MULTIPLE DEGREE OF FREEDOM SYSTEM 9

Formulation of equation of motion for multi degree of freedom (MDOF) system – Evaluation of natural frequencies and modes – Eigen values and Eigen vectors – Response to free and forced vibration of undamped and damped MDOF systems.

UNIT V THEORY OF SEISMIC PICKUPS 9

Introduction - The Physics of Operation - Parameter to be Measured - Seismometers - Displacement Pickups - Velocity Pickups - Accelerometers - Servo-accelerometers -Calibration of Accelerometers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the basic definitions and concepts of structural dynamics and mathematical modelling
CO2	Calculate the values for damped and undamped SDOF system.
CO3	Explain the response of SDOF systems to different types of loadings
CO4	Summarize the solution technique for dynamics of MDOF system.
CO5	Calculate the natural frequencies and mode shapes of SDOF and MDOF systems
CO6	Understand the working principles of instruments used in vibration recording and monitoring

TEXT BOOK:

1. Mario Paz, William Leigh, Structural Dynamics. Boston, MA: Springer, 2006.
2. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", 13th Edition, PHI Learning Private Limited, Delhi, 2014.

3. Anil K Chopra "Dynamics of Structures", 5th Edition, Pearson Education, 2020.

REFERENCES:

1. Damodarasamy S.R, Kavitha S, "Basics of Structural Dynamics and Aseismic Design", PHI Learning Private Limited, Delhi, 2009
2. Craig, R., Kurdila, A, "Fundamentals of Structural Dynamics" Wiley Publishers, 2011.

20CE919	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the principles of groundwater governing equations and characteristics of different aquifers.
- To impart knowledge on techniques of development and management of groundwater.
- To familiarize the Groundwater quality standards and conservative measures.

UNIT I HYDROGEOLOGICAL PARAMETERS 9

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GEC norms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well.

UNIT II WELL HYDRAULICS 9

Unsteady state flow - Theis method - Jacob method – Chow's method – Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery.

UNIT III GROUNDWATER MANAGEMENT 9

Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model.

UNIT IV GROUNDWATER QUALITY 9

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

UNIT V GROUNDWATER CONSERVATION 9

Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Describe aquifer properties and its dynamics.
CO2 Apply the knowledge of groundwater flow characteristics of well hydraulics.
CO3 Develop a model for groundwater management.
CO4 Explain the importance of artificial recharge and groundwater quality concepts.
CO5 Understand the techniques of conservation of groundwater.
CO6 Apply the concepts of groundwater for water resources management.

TEXTBOOKS:

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2021.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2018.

REFERENCES:

1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2020.
2. Ramakrishnan, S, "Ground Water", K.J. Graph arts, Chennai, 2015.
3. Chahar BR, "Groundwater hydrology", McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

20CE920	WATER RESOURCES SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of Mathematical approaches for managing the water resources system.
- To impart knowledge on water resource systems operation.
- To give exposure on simulation and optimization techniques.

UNIT I SYSTEM APPROACH 9

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

UNIT II LINEAR PROGRAMMING 9

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

UNIT III DYNAMIC PROGRAMMING 9

Bellman's optimality criteria, problem formulation and solutions – Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion.

UNIT IV SIMULATION 9

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

UNIT V ADVANCED OPTIMIZATION TECHNIQUES 9

Integer and parametric linear programming – Goal programming types – Applications to reservoir release optimization – application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Describe the economic aspects and analysis of water resources systems for comprehensive and integrated planning of a water resources project.
CO2	Apply the concept of linear programming for Optimization of water resources problems.
CO3	Apply the concept of dynamic programming for Optimization of water resources problems.
CO4	Develop the simulation model based on deterministic and stochastic simulation for reservoir operating policy.

CO5	Explain advance Optimization techniques in the field of water resources planning and management.
CO6	Demonstrate problem solving skills in operational research.

TEXTBOOKS:

1. Vedula, S., and Majumdar, P.P. "Water Resources Systems – Modeling Techniques and Analysis" Tata McGraw Hill, New Delhi, Fifth reprint, 2017.
2. Bhave PR, Water Resources Systems", Narosa Publishers, 2011

REFERENCES:

1. Gupta, P.K., and Hira D. S. "Problems in Operations Research", (Methods and Solutions), Sultan Chand and Sons, New Delhi, 2010.
2. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 2015.
3. Hiller, F.S., and Liebermann, G.J., "Introduction to Operations Research", McGraw Hill; 11th Edition, 2021.

		L	T	P	C
20CE921	**BRIDGE ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To give introduction to various bridge structures, selection and its design for different site conditions.
- To impart knowledge on the design of culverts and bridges.
- To familiarize the principles of design of bearings, pier and abutments.

UNIT I INTRODUCTION 9

History of bridges - Components of a bridge - Classification of road bridges - Selection of site and initial decision process - Survey and alignment; Geotechnical investigations and interpretations. River Bridge: Selection of Bridge site and planning - Collection of bridge design data - Hydrological calculation. Road Bridges - IRC codes - Standard Loading for Bridge Design - Influence lines for statically determinate and indeterminate structures - Transverse distribution of Live loads among deck longitudinal - Load combinations for different working state and limit state designs. Railway Bridges**:** Loadings for Railway Bridges; Railroad data. Pre-design considerations - Railroad vs. Highway bridges.

UNIT II DESIGN OF CULVERTS 9

General aspects, design loads, design moment, shear and thrust, design of critical section of Box and Pipe Culverts.

UNIT III DESIGN OF DECK SLAB AND T BEAM BRIDGES 9

Design of slab bridges: effective width analysis, design and detailing of deck slab bridges for IRC loading. Design of T beam bridges: wheel load analysis, bending moments in slab using Pigaud's theory, analysis of longitudinal girders using Courbon's theory.

UNIT IV DESIGN OF STEEL BRIDGES 9

Design of Truss Bridges – Plate girder bridge: Introduction – Elements and Design of Plate girder bridges.

UNIT V BEARINGS, PIER AND ABUTMENTS 9

Bearings: general features, types of bearings, forces on bearings, design principles of steel rocker and roller bearings, design and detailing of elastomeric pad bearing. Piers: general features, bed

block, materials for piers and abutments, types of piers, forces acting on piers, design of pier, stability analysis of piers. Abutments: general features of abutments, forces acting on abutments, stability analysis of abutments.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Calculate the loads on bridges for different type of bridges.
CO2 Design the box and pipe culverts.
CO3 Analyse and design reinforced concrete deck slab.
CO4 Analyse and design the T-beam bridges by various methods.
CO5 Design the trussed bridge and plate girder bridges.
CO6 Analyse and design the bridge bearings, piers and abutments.

TEXTBOOKS:

1. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", 3rd Edition, Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2020.
2. Johnson Victor D., "Essentials of Bridge Engineering", 6th Edition, Oxford and IBH Publishing Co., New Delhi, 2019.

REFERENCES:

1. Design of Concrete Bridges: As per Latest IRC Codes, Wiley, 2020.
2. Krishna Raju. N. "Design of Bridges", 5th Edition, Oxford & IBH, New Delhi 2019.
3. Ponnuswamy.S., "Bridge Engineering", 3rd Edition, Tata McGraw Hill Publications, New Delhi, India 2017.
4. IRC: 6-2000, "Standard Specifications and Code of Practice for Road Bridges, Section-II Loads and Load Combinations (Seventh Revision)"- Amendment IRC-6 Oct 2019.
5. IRC: 24-2000 "Standard specifications & code of practice for steel bridges", Section V – Steel Road Bridges (Limit State Method) (Third Revision).
6. IRC: 83 -2015 (Part I), "Standard specifications & Code of practice for Road Bridges". Section: IX Bearing, Part I – Roller & Rocker Bearings. (Second Revision)
7. IRC: 83 -2018 (Part II), "Standard specifications & Code of practice for Road Bridges". Section: IX Bearing, Part II – Elastomeric Bearings. (Second Revision)
8. IRS: 2, "Code of practice for plain, reinforced and prestressed concrete for general bridge construction", 2014

		L	T	P	C
20CE922	**MUNICIPAL SOLID WASTE MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the sources, characteristics and types of municipal solid wastes.
- To impart knowledge on, on-site storage methods and processing techniques.
- To provide an exposure on various methods of land disposal and management of leachate.

UNIT I SOURCES AND CHARACTERISTICS 8

Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization - Effects of improper disposal of solid wastes-Public health and environmental effects - Elements of solid waste management –Social and Financial aspects – Municipal solid waste (M&H) rules – integrated solid waste management-Public Awareness- Role of NGO's- Public Private participation.

UNIT II ON-SITE STORAGE AND PROCESSING 8

On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and environmental aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling of plastic waste –Construction and Demolition waste.

UNIT III COLLECTION AND TRANSFER 8

Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection systems - Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems - solving.

UNIT IV OFF-SITE PROCESSING 12

Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation - Thermal processing options – case studies under Indian conditions.

UNIT V DISPOSAL 9

Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite Rehabilitation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Describe the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management.
CO2	Explain the segregation of solid waste and onsite storage methods.
CO3	Analyze various transfer methods and identify site condition for the transfer station.
CO4	Develop appropriate methods for processing and disposal of solid and hazardous wastes.
CO5	Understand appropriate disposal methods and its handling in an efficient manner.
CO6	Explain the concepts of site selection, design and operation of sanitary landfills.

TEXTBOOKS:

1. Cherry P M, “Solid and Hazardous Waste Management”, CBS publishers and distributors Pvt Ltd, 2018.
2. Rao M.N, Razia Sultana, Sri Harsha Kota, “Solid and hazardous waste management – Science and Engineering”, Butterworth-Heinemann, 2016.

REFERENCES:

1. “Manual on Municipal Solid waste management”, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi., 2016.
2. George Tchobanoglous and FrankKreith “Handbook of Solid waste management”, McGraw Hill, New York, 2002.

		L	T	P	C
20CB404	**INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP**	**3**	**0**	**0**	**3**

OBJECTIVES:

- Develop mindsets to pursue entrepreneurship.
- Understand the basics of Innovation and Entrepreneurship
- Create, protect, assetize and commercialize intellectual property?
- Identify and discover market needs
- Manage an innovation program
- Understand opportunities and challenges for entrepreneurs through Startup Models

UNIT I INNOVATION **9**

Innovation Types of Innovation Incremental, disruptive, Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.), Challenges in Innovation (time, cost, data, infrastructure, etc.)

UNIT II IPR **9**

Types of IPR (patents, copyrights, trademarks, GI, etc.) Lifecycle of IP (creation, protection, assetization, commercialization), Balancing IP Risks and Rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer and licensing)

UNIT III ENTREPRENEURSHIP **9**

Opportunity Identification in Technology Entrepreneurship (customer pain points, competitive context) Market Research, Segmentation and Sizing Product Positioning, Pricing, and Go-To-Market Strategy IP Valuation (methods, examples, limitations)

UNIT IV TYPES OF STARTUP BUSINESS MODEL **9**

Startup Business Models (fund raising, market segments, channels, etc.) Co- innovation and Open Innovation (academia, startups, corporates) Technology Innovation: Two Case Studies.

UNIT V PROCESSES IN STARTUP BUSINESS MODEL **9**

Innovation, Incubation and Entrepreneurship in Corporate Context Technology-driven Social Innovation and Entrepreneurship Manage Innovation, IP and Entrepreneurship Programs – Processes, Governance and Tools

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the basics of Innovation and Entrepreneurship
CO2	Manage an innovation program
CO3	Create, protect, assetize and commercialize intellectual property
CO4	Understand opportunities and challenges for entrepreneurs
CO5	Developing mindsets to pursue entrepreneurship
CO6	Identify and discover market needs

TEXT BOOKS:

1. Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth Navi Radjou,Jaideep Prabhu, Simone Ahuja , John Wiley & Sons, 2012.

REFERENCES:

1. Identifying Entrepreneurial Opportunities: Cognition and Categorization in Nascent Entrepreneurs, Matthew J. Karlesky, University of Michigan, 2015.
2. http://www.businessdictionary.com/definition/entrepreneurship
3. https://www.infoentrepreneurs.org/en/guides/use-innovation-to-grow- your- business/
4. http://sourcesofinsight.com/innovation-life-cycle/
5. https://www.investottawa.ca/
6. https://www.Lead-innovation.com

OPEN ELECTIVES (OE)

(Offered to other Departments)

		L	T	P	C
20CE001	**CLIMATE CHANGE AND ITS IMPACT**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide an understanding of terminologies used in climatology.
- To introduce the concept of climate change models at regional and global level.
- To impart knowledge on the impact of climate change with an emphasis on sustainable development of natural resources.

UNIT I INTRODUCTION TO WEATHER AND CLIMATE 9

Atmosphere – Climatology and Paleo climatology - Factors affecting global, regional and local climates - Weather parameters - Tropical climate – Monsoons - Polar, Desert, Mid-latitude climates
and their role in global climate change.

UNIT II NATIONAL ACTION PLAN ON CLIMATE CHANGE 9

National and State Action Plan on Climate Change - Significance on Sustainable development of Natural resources – National Water Mission, Sustainable Agriculture Mission, Green India Mission,
Coastal Conservation.

UNIT III CLIMATE CHANGE MODELS 9

Global and Regional Climate Scenarios – Representative Concentration Pathways (RCP) for peak and decline scenario, long-term emission of greenhouse gases, temperature change and high emissions - Global Circulation Model (GCM) - Statistical and Dynamical Downscaling of GCM – Regional Climate Model (RCM).

UNIT IV VALIDATION AND APPLICATION OF MODELS 9

Climate Projections- Model Construction, Observations, Assimilation - Validation of climate models in Practice – Uncertainty analysis – Bias Correction – Sectoral wise Case Studies in India.

UNIT V IMPACT OF CLIMATE CHANGE 9

Definitions of Risk, Hazards, Exposure, Sensitivity and Vulnerability - Climate Risk Assessment - IPCC Methodology – Impacts and Vulnerability on Water, Agriculture, Forestry, Coastal and Health - Vulnerability indices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Understand the terminologies involved in climatology and their role in global climate change.
CO2	Explain the national and state action plan on climate change.
CO3	Discuss the missions developed with respect to sustainable development of natural resources.
CO4	Describe the climate change scenarios at regional and global level and the working of regional and global climate models.
CO5	Appraise the application of climate change models in India.
CO6	Summarize the impact of climate change on the concept of vulnerability indices.

TEXTBOOKS:

1. Barrie Pittock, "Climate Change – The Science, Impacts and Solutions", 2nd Edition, CSIRO Publishing, 2009.
2. Robin Mcilveen, "Fundamentals of weather and climate", 2nd Edition, Oxford University Press, 2010.
3. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press, 2011.

REFERENCES:

1. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication, 2011.
2. India's National Action Plan on Climate Change (NAPCC), Government of India, 2018.
3. IPCC sixth Assessment Report - Climate Change 2021: The Physical Science Basis, 2021.
4. W. Neil Adger, Irene Lorenzoni and Karen L. O, "Adapting to Climate Change: Thresholds, Values", Governance, Cambridge, 2009.
5. Vineet Kumar, Arjuna Srinidhi, Chandra Bhushan, Geetika Singh, "Rising to the Call: Good

Practices of Climate Change Adaptation in India", Centre for Science and Environment publisher, 2014.

20CE002	GREEN BUILDING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give introduction to the concept of green building, benefits and rating systems.
- To create exposure to selection of site, material, planning and energy efficient design of green building
- To provide knowledge on indoor air quality during operation and maintenance of green building.

UNIT I INTRODUCTION 9

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems.

UNIT II SITE SELECTION AND PLANNING 9

Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect, maximize comfort by proper orientation of building facades, day lighting, ventilation, etc. Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems.

UNIT III ENERGY EFFICIENT DESIGN 9

Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT IV MATERIALS FOR GREEN BUILDING 9

Building Materials: Methods to reduce embodied energy in building materials - Use of local building materials - Use of natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks - use of materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste - reuse of waste and salvaged materials Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management.

UNIT V INDOOR ENVIRONMENTAL QUALITY AND OCCUPATIONAL HEALTH 9

Indoor Environmental Quality for Occupant Comfort and Wellbeing: Daylighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics. Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc. – Operation and maintenance of green building.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Describe the benefits of green buildings towards sustainable development and to rate the green building based on various rating systems.

CO2	Plan and design a green building with proper lighting, ventilation and efficient water conservation.
CO3	Design energy efficient green building by using energy efficient appliances for lighting, heating and air-conditioning systems.
CO4	Select natural and renewable materials for sustainable development.
CO5	Demonstrate methods of handling construction waste materials, effective utilization and management of household waste.
CO6	Explain the indoor environmental quality, codes related to green buildings, operation and maintenance of green building.

TEXTBOOKS:

1. Jagadish, K S, Venkataramareddy, B U and Nanjundarao K. S, "Alternative Building Materials and Technologies" New Age International, 2017.
2. Harshul Savla, "Green Building: Principles & Practices", Kindle Edition, 2021
3. "Sustainable Building Design Manual" Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCES:

1. Osman Attmann "Green Architecture Advanced Technologies and Materials", McGraw Hill, 2010.
2. Jerry Yudelson "Green building Through Integrated Design", McGraw Hill, 2009.
3. "Fundamentals of Integrated Design for Sustainable Building" by Marian Keeler, Bill Burke, 2009.
4. Mike Montoya "Green Building Fundamentals", Pearson, USA, 2010.

		L	T	P	C
20CE003	**GEOGRAPHIC INFORMATION SYSTEM**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System.
- To give exposure on Database Management system and GIS data models.
- To impart knowledge on spatial data structures, input, management and output processes.

UNIT I INTRODUCTION TO MAPS AND GIS 9

Maps – Definition – Scale - Types of Maps – Elements of Map – Projection – purpose - types – Coordinate Systems: Geographic, Rectangular and Polar – Transformations - types and application – GIS: Introduction - History– Components – Applications of GIS - Popular GIS software – Opensource GIS software.

UNIT II DBMS AND GIS DATA MODEL 9

Database Management system – function – types – advantages - Entity Relationship Model - Normalization - GIS Data Model - Introduction- Data Encoding - Vector Data Structure - Raster Data structure – Network Data Structure - Comparison of Vector and Raster Data Structure – Open Database Connectivity (ODBC).

UNIT III GIS DATA INPUT 9

Sources for GIS Data - Vector Data Input – Georeferencing – Topology – Topological Relationship - Raster Data Input – Errors in input – Data Editing – Linking Attribute Data – Raster File Formats – Vector File Formats – Raster to Vector and Vector to Raster Conversion - OGC standards.

UNIT IV GIS DATA ANALYSIS 9

Introduction to spatial analysis - Raster Data Spatial Analysis: Local, Neighbourhood, Zonal Operations - Vector Operations and Analysis: Topological and Non-topological operations - Network Analysis – DEM – Surface Analysis.

UNIT V GIS OUTPUT DESIGN AND PRESENTATION 9

Introduction - Spatial and Non-spatial Data presentation - Map layout – Charts, Graphs and Multimedia output – Elements of Spatial Data Quality – Meta Data - Introduction to Web GIS – Applications in Civil Engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1 Describe the fundamentals of maps and their characteristics, GIS & its components.
CO2 Demonstrate various spatial data models and their advantages.
CO3 Identify GIS Data sources, data input, data editing and conversion.
CO4 Carryout raster and vector data analysis for various applications.
CO5 Explain the spatial information along with quality assessment for applications.
CO6 Identify an error free GIS database for civil engineering applications.

TEXTBOOKS:

1. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Book Company, 9th Edition, 2019.
2. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, Saylor Foundation, 2011.
3. Michael N. DeMers, Fundamentals of Geographic Information Systems, Wiley, 4th Edition, 2009.
4. Ian Heywood, Sarah Cornelius, Steve Carver, An Introduction to Geographical Information Systems, Prentice Hall, 4th Edition, 2011.

REFERENCES:

1. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, Geographic Information Science and Systems, Wiley, 4th Edition, 2015.
2. David Smith, Understanding GIS - An ArcGIS Pro Project Workbook, Environmental Systems Research, 4th Edition, 2018.

		L	T	P	C
20CE004	**AIR POLLUTION AND CONTROL ENGINEERING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on the principle and design of control of indoor/particulate/gaseous air pollutant and its emerging trends.
- To introduce various methods of controlling the levels of pollution in real time by using various equipment and techniques.
- To create awareness on indoor air quality management to maintain quality standards.

UNIT I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility - Ambient Air Quality and Emission standards –Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT II METEOROLOGY 9

Effects of meteorology on Air Pollution- Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories- Dispersion models, Plume rise.

UNIT III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT V INDOOR AIR QUALITY MANAGEMENT 9

Sources, types and control of indoor air pollutants, sick building syndrome and building related illness - Sources and Effects of Noise Pollution – Measurement - Standards - Control and Preventive measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1	Summarize the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management.
CO2	Identify, formulate and solve air pollution problems.
CO3	Design stacks and particulate air pollution control devices to meet applicable standards.
CO4	Select control equipment for gaseous contaminants.
CO5	Ensure air quality control and preventive measures for air pollution.
CO6	Apply all quality management measures in the real time applications.

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC, 2018.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press, Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2020.

REFERENCES:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2020.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2018.
3. Wayne T. Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2020.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2017.
5. C.S.Rao, "Environmental Pollution Control Engineering", New Age International(P) Limited Publishers, 2021.

		L	T	P	C
20CE005	**WASTEWATER TREATMENT**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on Regulations and Environmental concerns in Waste water management.
- To introduce chemical and biological processes in treatment of waste water.
- To create awareness on advanced water treatment processes to improve the quality of treatment.

UNIT I WASTE WATER TREATMENT - AN OVERVIEW 9

Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents.

UNIT II PROCESS ANALYSIS AND SELECTION 9

Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modeling of ideal and non-ideal flow in Reactors – Process Selection.

UNIT III CHEMICAL UNIT PROCESSES 9

Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage.

UNIT IV BIOLOGICAL TREATMENT 9

Overview of biological Treatment – Microbial metabolism – Bacterial growth and energetics – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT V ADVANCED WASTE WATER TREATMENT 9

Technologies used in advanced treatment – Classification of technologies - Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration - Absorption – Ion Exchange – Advanced oxidation process.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

- **CO1** Summarize the health and environmental concerns in waste water management.
- **CO2** Identify and analyze processes for waste water treatment.
- **CO3** Design chemical process units for treatment of waste water.
- **CO4** Use biological treatment processes to remove micro-organisms.
- **CO5** Choose advanced water treatment processes to improve the quality of treatment.
- **CO6** Apply all treatment process in the real time industries to treat waste water.

TEXT BOOKS:

1. Metcalf and Eddy, "Wastewater Engineering", 4th ed., McGraw Hill Higher Edu., 2020.
2. W. Wesley Eckenfelder, Jr., "Industrial Water Pollution Control", McGraw Hill Inc., 2019.
3. Garg, S.K., "Environmental Engineering" Vol. II, Khanna Publishers, New Delhi, 2019.

REFERENCES:

1. Mahajan S P, "Pollution control in process industries", 34th Ed. Tata McGraw Hill Publishing Company Ltd., 2021.
2. Lancaster M, Green Chemistry: An Introductory Text, RSC publishing, 2020.
3. C.S. Rao C S, Environmental Pollution Control Engineering, New Age International, 2017.
4. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2019.
5. Punmia, B.C. and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2020.